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ORIGINAL COMMUNICATIONS.

SYRINGOMYELIA.

BEING THE ALVARENGA PRIZE ESSAY OF THE COLLEGE OF
PHYSICIANS OF PHILADELPHIA FOR THE YEAR 1895.

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It is over one hundred and fifty years since Morgagni and Santorini observed and recorded the existence of an abnormal cavity in the spinal cord.

Portal in the year 1800, and Rachetti in 1816, also noted this strange phenomenon, which had from time to time excited the curiosity of anatomists of the seventeenth and eighteenth centuries. The pathological condition passed without a distinctive name until, in 1837, Ollivier, of Angers, called the affection "syringomyelia," by which it has since been generally designated. The word itself is from the Greek *συριγγῶ*, "to become hollow," and *μυελός*, "marrow," a combination which clearly expresses the macroscopic appearance when section is made of a typical specimen. The next step was the discovery in 1859, by Stilling, that the spinal cord is normally provided with a central canal which is constant throughout life. Virchow and Leyden then looked upon all cavities in the cord as expansions of the normal central canal, and termed the condition "hydromyelia." Ollivier is said to have attributed to the affection very little pathological significance, and certainly did not connect the condition with any clinical symptoms; thus all writers down to within twenty years or even less gave very little value to the condition other than as being merely a pathological curiosity and of little importance. It transpired, however, that in cases where these cavities were found at an autopsy the clinical histories bore a strong resem-

blance in some respects. Disorders of sensation had been observed; burns and wounds received during later years had been sustained without pain; certain muscles had wasted and there had been the symptoms of muscular weakness to such an extent as to interfere with the customary avocations. It thus became evident that the cavity and the surrounding histologic change were accountable for a train of clinical symptoms which had not been heretofore attributed to a definite locality in the central nervous system.

The first differentiation of these cases was made when a pathological condition, evidently congenital, was distinguished from a cavity acquired in later life as the result of accidental causes or the growth of new formations in the spinal cord. For the congenital affection it has been found convenient to retain the name *hydromyelia*; but for the cavities secondarily produced, even though they may be considered as remotely due to a developmental defect dating as far back as intra-uterine existence, it has generally been the custom to use the term *syringomyelia*, as originally proposed.

FIG. 1.



Hydromyelia from a child two years old, with encephalocele and absence of cerebellum. (From Gowers, after Leyden.) In A, cervical region, the central canal is large, lined with epithelium, and from it a median fissure extends backward nearly to the periphery of the cord, limited by a layer of homogeneous tissue, more abundant at the posterior limit. In B, lower down, the fissure is enlarged to a cavity of considerable size, while in C it is still larger, and the posterior columns are reduced to a narrow zone between the layer of tissue which bounds the cavity and the gray substance.

The definition which we adopt, and to which every author will doubtless assent, is that *syringomyelia* is a chronic affection of the spinal cord characterized anatomically by the pathological formation of cavities in its substance, and clinically by peculiar disturbances of sensibility associated with trophic disorders. The seat of the primary lesion may extend as high as the medulla or as far downward as the lumbar region; the seat of the secondary changes is peripheral, involving the muscles, the bones, the cellular tissue, the skin, etc.

Two other terms have been proposed, but they have not been accepted by the profession. One is "*myélite cavitaire*," of Joffroy and Achard, which indicates the secondary nature of the cavity, but it is objectionable on account of the term *myelitis*, which, in the usual acceptance of the term, misrepresents the primary pathological condition.

The other name, proposed by Sachs and Armstrong, is *myelosyringosis*. The term is no doubt a correct one for the condition, but it is not so euphonious as *syringomyelia*, and will probably never come into use.

It was a distinct step in advance when it was recognized by Hallopeau, in 1869, that it was not so much the cavity *per se* that was the main element

in the pathological condition, but rather that the cellular changes which take place in the cord constitute the primary lesion, and that the dilatation of the cavity is only secondary. Hallopeau's explanation was that a myelitis occurred with sclerosis of the periependymal tissue; as the latter gave way the central canal was thus secondarily excavated into a large cavity.

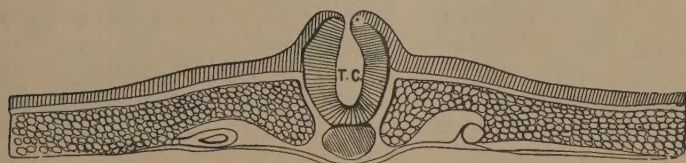
This statement seemed beyond criticism until further studies revealed cavities in the cord independent of the central canal and not even communicating with it.

Simon, of Paris, contributed much to the elucidation of the subject, which had now become greatly confused owing to the successive change of views. His studies, which were published in 1875, called attention to the coexistence of the cavity with vascular tumors, to which he gave the name of "gliomes telangiectasiques," and rightly claimed that the cavity resulted from softening of the glioma and absorption of the degenerated structure.

In Simon's opinion, which is now generally adopted, hydromyelia was reserved for "*la dilatation et l'hydropisie du canal d'ependyme, affection en tout comparable à l'hydrocéphalie*," and to use the word syringomyelia to designate "*les cavités et productions kystiques que l'on peut rencontrer dans la moelle indépendamment du canal central*."

Much more attention has been directed in later years to the study of the symptomatology of syringomyelia. The train of clinical symptoms and their explanation by post-mortem studies furnish one of the most beautiful subjects for the student of clinical medicine and pathology. The statement that a diagnosis can only be made at the autopsy has been relegated to history. The rigorous efforts of Morvan to establish an identity for the disease, which he described as "*paralysie analgésique*" or "*parésie analgésique à paralysie des extrémités supérieures*," have likewise been unsuccessful, for the best observers are now nearly united in classifying this affection as one of the forms or types of syringomyelia and not a disease *sui generis*.

FIG. 2.



Transverse section of a chick showing medullary canal (T. C.) beginning to close.
(From Kölliker.)

The various forms of this interesting disease, which is already the subject of a vast amount of literature,¹ will be considered more particularly in succeeding chapters.

Histology and Pathology.—In the development of the spinal cord of the embryo the germinal space or area in its very earliest stage takes on an

¹ In the bibliography prepared by the author there are 500 references

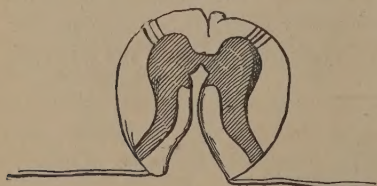
elongated form, a central longitudinal line called the primitive groove. The sides of this primitive furrow are composed of two longitudinal ridges of the external layer or fold (epiblast) of the blastoderm.

These close in so as to form a canal constituting the fundamental central canal of the cord, the fourth ventricle (which is only partially enclosed), and the ventricles of the brain. The walls of this canal are thinner in front and behind than at the sides, and the epithelium of the central canal is derived from the same external layer (epiblast) of the blastoderm, the nerve elements themselves being derived from the middle layer, the mesoblast, subjacent to this epithelium. The central canal is at first closed behind by only a thin layer of cells which meet across the middle line, the remnant of this fissure forming the posterior median fissure, the closure occurring from behind forward as the median parts of the posterior columns develop.

The nature of the cellular constituents of the cord must be also understood in an explanation of the pathological changes. All the parts consist first of embryonal cells, or plasmatic cells as they are sometimes called,—embryonic cells, because they are the same in the adult as they were in the embryonic stage. Such cells easily undergo transformation, however, decaying, perhaps, or furnishing new forms that become pathological.

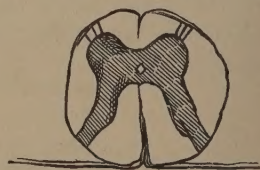
As the embryo develops, some of the embryonal cells are transformed into the nerve-elements, the cells of the gray matter taking shape before the fibres of the white columns. Others persist, forming the neuroglia and the gelatinous gray substance continuous with it around the cord, at the posterior root fissure and around the central canal (Gowers).

FIG. 3.



Representing the posterior end of the spinal canal open. The anterior and lateral columns have been formed. The posterior columns encroach on the canal.

FIG. 4.



Development of the cord complete by the growth of the posterior median column. The spinal canal is closed.

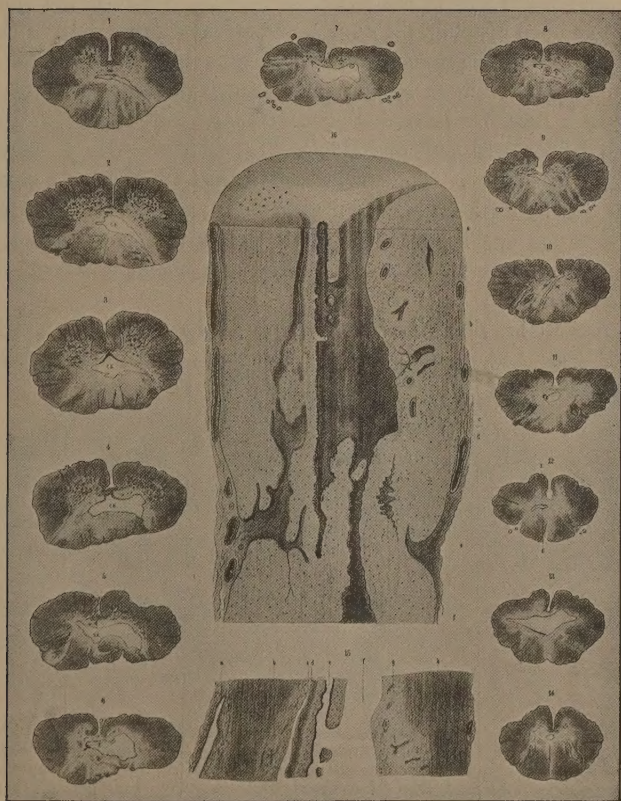
It is therefore to be noted that the cells surrounding the central canal and extending to the posterior root fissure are the very cells most prone to undergo transformation. The central canal is finally located in the anterior part or middle of the gray commissure. It is barely discernible to the naked eye either as a slit extending laterally or antero-posteriorly, or circular in section, or may, in exceptional cases, be normally closed by the epithelium which usually lines its wall.

The development of the cord may stop at several stages short of comple-

tion. The central canal may remain abnormally large in proportion as the junction of the dorsal portion of the cord occurs at any position between the normal one and the hindmost limit of the posterior fissure.

The boundaries of the canal may be symmetrical or, if the junction has taken place unevenly, a portion of the original posterior fissure, or an offset from it, may be thrown sideways into either the right or left posterior column, decentering the cavity and giving it an asymmetrical outline.

FIG. 5.



Syringomyelia. Case of E. Asmus. Cavity extends from the third cervical to the tenth dorsal segment. The right posterior horn chiefly affected. The anterior horns intact. Specific history.

It has been suggested also that in some cases the cord may be normally developed as far as external appearance goes, but may contain an undue amount of embryonic neuroglia, in which a hemorrhage or liquefactive degeneration may easily be determined by degrees of violence which would be insufficient to affect a normal cord.

It can therefore readily be understood that in some cases of syringomyelia we may deal with a congenital weakness if not an actual defect, a

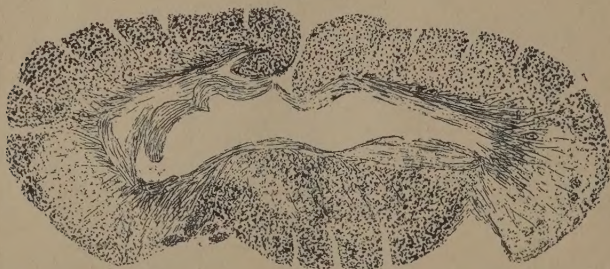
developmental irregularity in the distribution of cellular elements; that, furthermore, the filling up of congenital or acquired spaces in the neuroglial element with the products of some new formation, glioma for example, and the exercise of pressure from within outward, will react upon the gray matter, so that as it degenerates the intrinsic symptoms of the disease present themselves, and as later the white matter itself undergoes transformation, the extrinsic symptoms are added to the list.

Pathology.—On examining the cord as it lies in the vertebral canal the general appearance may be entirely normal. The meninges are apparently healthy, but upon opening the dura mater, if the case be well marked, the cord will bear a strong resemblance to a large blood-vessel filled with a moderate quantity of fluid, having walls reduced in thickness in proportion as the gray matter has been destroyed. On pressure it is found to lack resistance, being soft and fluctuating. In extreme cases it may be of ribbon-like appearance. The cervical enlargement is relatively great, or at whatever locality a glioma may be present there may be a fusiform swelling. The cervical and upper dorsal regions are the usual seats of the affection.

The external appearance is not always so characteristic in cases of moderate degree.

On cross-section the distinctive features of the disease are apparent to the naked eye. In successive sections of a well-marked specimen we may trace the glioma and its cavity throughout its vertical extent.

FIG. 6.¹

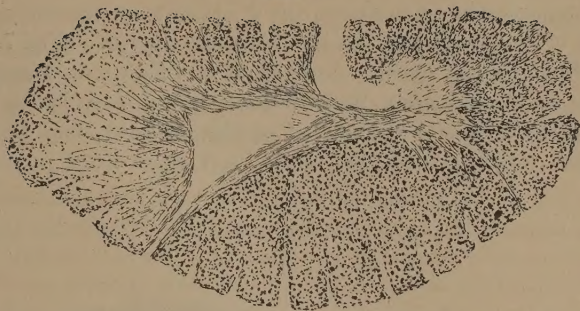


SYRINGOMYELIA.—Upper cervical region. Here the cavity extends far across the cord, almost symmetrically on either side. The gliomatous formation extends out along the posterior horns, almost cutting off the posterior columns from the rest of the cord. The lateral tracts are much degenerated, especially the right, and the right direct pyramidal tract. Remnants of the anterior horns can be made out as narrow projections in front of the cavity (the left alone is shown in the drawing); they contain only a few multipolar cells degenerated. The anterior parts, especially, of the posterior columns, are degenerated. But little trace of posterior root-zone. The gliomatous tissue extends almost entirely around the cavity as a rim or circle.

The cavity is usually single, but there may be several cavities independent of each other or intercommunicating. The cross-section of the cavity is generally elliptical, or merely a narrow slit with the long diameter

¹ The author wishes to express his indebtedness to Dr. James Hendrie Lloyd for the use of these valuable illustrations, which were executed from photographs by Dr. William M. Gray, of the Army Medical Museum, Washington.

FIG. 7.



This drawing represents very well a section from the mid-dorsal region. (The image is reversed.) The cavity is to the right (left in figure), and follows out the posterior horn quite to the periphery. The right lateral tract is very much degenerated, and the left is rather more so than is shown in the drawing. The right anterior horn is also practically destroyed. The left anterior horn preserves its shape, and under the microscope some motor cells are visible in it. The posterior columns show degenerated fibres scattered through them.

FIG. 8.



SYRINGOMYELIA.—Cervical enlargement. The cavity here begins to trend towards the right side (left in the photograph). It is lined with a gliomatous material. Remains of the central canal can be seen in a group of epithelial cells in front of the cavity and to one side of its normal position. It presents irregularly the outlines of a double canal. It does not appear in the photograph. The anterior white commissure is preserved. The gray matter is stretched around the ends of the cavity, and only a few multipolar cells are visible (very indistinct in this photograph) in the anterior horns. The lateral pyramidal tract is deeply degenerated, and the direct pyramidal tract slightly so. The posterior horns and root-zones cannot be well distinguished.

transverse (Figs. 6, 8, 9, 10). The shape of the cavity varies very largely, and its long axis may lie in almost any direction, very commonly extending obliquely in the direction of one of the posterior horns. (Fig. 7.)

The dimensions of cavities vary greatly in different cases and at different levels in the same case, measuring one millimetre or less up to almost the entire thickness of the cord, and usually attaining their maximum in the cervical region. While the cervical and upper dorsal portions of the

FIG. 9.



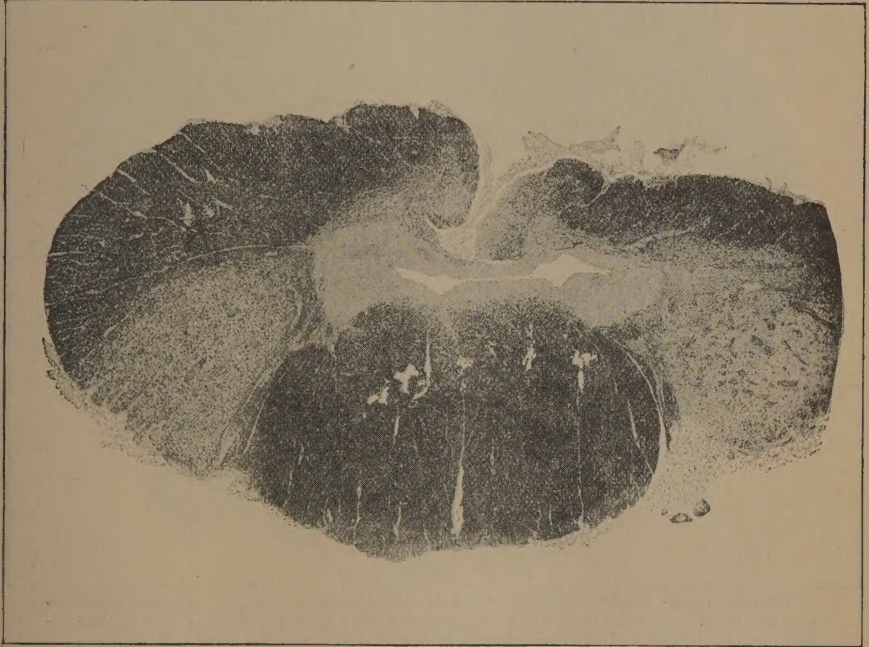
SYRINGOMYELIA.—Cervical enlargement. Cervical region next below Fig. 8. Cavity trends still farther to right. (In this the image is not reversed.) The anterior horn can be well distinguished. It contains more multipolar cells than the former section, but under a high power they are seen to be degenerated. Otherwise the appearances are much the same as in section from which Fig. 8 is taken. The direct pyramidal tract on the right is more degenerated than on the left. The anterior portion, especially, of the columns of Goll are involved in gliomatosis.

cord are the usual seat of cavities, they have been observed in the lumbar enlargement alone.

Position.—The cavity itself always lies in the gray matter primarily. It occupies very frequently the position of the central canal in the perpendymal tissue. It is often observed posterior to the canal in the gray substance forming the posterior commissure, and may extend throughout one or both of the anterior or posterior horns, reaching thus to the very margin of the cord. In such cases the cavity is asymmetrical, lying chiefly in either the right or the left half. The white matter in moderate cases is

unaffected, but where the cavity is large, and pressure from the glioma has become great, the white matter is in its turn involved, being crowded to the periphery and more or less unable to carry on its functions. The anterior columns of the white substance preserve their integrity to the last. We are unable to point to a single case in which these have been affected. Since the defect is originally posterior, it is natural that the columns of

FIG. 10.



SYRINGOMYELIA.—Upper dorsal region. The cavity trends to the right (image not reversed). The gliomatous tissue extends down both posterior horns. All around it the white, as well as gray, matter is degenerated, especially in the direct and crossed pyramidal tracts (more marked in the right). The anterior parts of the posterior columns also are affected. The gray matter is almost entirely destroyed, except the anterior horns, which are seen as mere small projections in front of the cavity. They contain but few cells.

Goll and Burdach should be the first of the white matter to undergo a change. The trophic columns of Clark, at the neck of the posterior roots (gray matter), are also often affected. The initial situation of the glioma is about the central canal, extending thence to Clark's column, and then to the anterior and posterior horns.

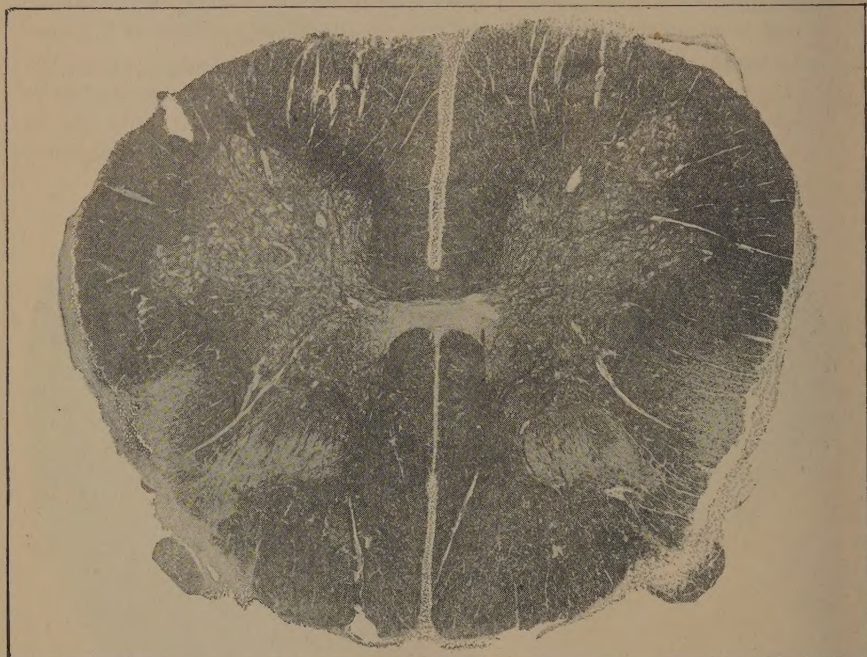
In fifty-six cases where autopsies were made the lesion was located as follows :

CASES (Baumler).

Posterior horns.....	21	Left posterior.....	6
Anterior horns.....	14	Right anterior.....	5
Right posterior.....	5	Left anterior.....	5

The lateral columns, and particularly the pyramidal tracts when involved, as they occasionally are, produce paraplegia. The invasion of the columns of Burdach and Goll gives rise to sensory phenomena, while the degeneration of Clark's column probably is accountable for the trophic changes.

FIG. 11.



SYRINGOMYELIA.—Lumbar enlargement. The cord here presents a striking contrast to its appearance higher up. Its general shape and size, as well as those of its gray matter, are normal. The anterior horns are large and well supplied with motor cells. The posterior horns and root-zones are plainly seen. In but two features does it present very marked abnormal appearances; and these, in view of the diseased state of the cord higher up, are full of interest. First, the lateral, or crossed, pyramidal tracts, which are here small and have come to the periphery, are degenerated. Second, the region of the central canal, in the posterior gray commissure, shows distinctly gliomatous change. Already the central canal is obliterated, but no gliomatous cavity has yet taken the place of the normal one. Dr. Lloyd remarks that this proves very beautifully that the cavity in syringomyelia is *not* a mere expansion of the normal canal. On the contrary, the normal canal does not exist any longer, and its place is taken by the remains of its columnar epithelial cells, which have undergone coagulation necrosis with loss of their characteristic columnar appearance. This group of broken-down cells is surrounded by the gliomatous mass, which at this level occupies but a small space in the gray commissure. We see here, probably, an early stage of the gliomatous process at the lowest point of its downward progression in the cord. Slight degeneration is seen here in the posterior columns near the periphery.

If the new formation give rise to pressure in an extreme degree there may be hemorrhages, inflammation, and evidences of degeneration. In such an event it would be the gray matter of the cord that would show the hemorrhage and inflammation, while the white columns would undergo degeneration. This latter would be, as a rule, ascending, for it is the posterior and lateral columns that are most frequently attacked. Inasmuch as sensory disorders constitute the corner-stone of the diagnosis of syringo-

myelia, it is quite likely that the proportion of cases in which the posterior columns are affected (sixty-two per cent. according to Wichmann) is considerably greater than has been recognized hitherto. In the one hundred and eighteen cases published which we have carefully examined, nine cases, or eight per cent., showed degeneration of the posterior columns, while a larger majority showed sensory changes. It should be remembered, however, that it is possible for syringomyelia to exist without any sensory disorder. In a case of Schlesinger's (VI. Monograph, 1895), there was no anæsthesia of any form, but an autopsy revealed a cavity extending nearly the entire length of the cord. Ascending degeneration was found in Lloyd's case, in which the patient's motor symptoms were more marked on the right side, and the left pyramid degenerated above the cavity.

FIG. 12.



Ascending Degeneration in Syringomyelia. (Medulla Oblongata, Lloyd).—*Ng*, nucleus funiculi gracilis; *Nc*, nucleus funiculi cuneati; *F*, funiculus cuneatus; *Sub g*, substantia gelatinosa; *XI*, accessory nerve; *DC*, direct cerebellar tract; *V*, ascending root of fifth nerve; *Ph*, posterior horn; *G*, Gowers' tract; *Ah*, anterior horn; *D*, decussation of pyramids; *Pyr*, left pyramid.

The light, unshaded areas are degenerated. The central canal is surrounded with gliomatous material. The fibres of the accessory nerve are too diagrammatic. They are not so distinct in the section.

The section shown in Fig. 12 was made at about the region of the decussation of the pyramids. The central canal, lined with epithelium, is seen. It is surrounded by gliomatous material, which has not yet begun to break down into a cavity, although under the microscope it is seen to be brittle and friable. The decussating fibres are seen and the remnants of the anterior horns cut off by them, lying to their outer side. It is to be noted that the fibres running towards the right are much more numerous than those running in the opposite direction; also, that the left pyramid is degenerated.

In another case, which recently died in the Philadelphia Hospital (see Fig. 15), ascending degeneration of the pyramidal tracts was found by Der-

cum and Spiller. In this case sections were made from the level of nearly every spinal root and from many spinal ganglia.

By the microscopic examination degeneration of the crossed pyramidal tract was found as high as the substantia reticularis of the second cervical segment and of the direct pyramidal as high as the motor decussation upon the right side, and for a short distance of the crossed pyramidal upon the left. This was believed to be ascending on account of the following facts:

1. Absence of any microscopic lesion above the medulla oblongata.
2. Degeneration of the crossed and direct pyramidal tracts on the same side of the cervical cord, intense in the lower cervical region near the lesion, and diminishing gradually in intensity in the cervical segments, and finally becoming very indistinct in the upper cervical region.
3. Absence of all degeneration in the anterior pyramids.
4. Long duration of a chronic process.

While certain associative fibres may be considered degenerated in these columns, the entire antero-lateral column contains such fibres, and the degeneration was notably in the area occupied by the crossed and the direct pyramidal tract. This ascending sclerosis was probably in greater part due to destruction of motor fibers deprived of their function.

Degeneration of the direct cerebellar tracts and of the tracts of Gowers was traced as far as the inferior peduncles of the cerebellum. Intense pachymeningitis was noticed from the second lumbar segment to the exit of the third dorsal roots. The arthropathy of the right shoulder was not due to any special changes in the cord or spinal ganglia. The posterior roots were not affected even where the pachymeningitis was most intense; the anterior roots at one part of the dorsal cord were degenerated. In the entire cervical region as high as the second cervical segment the cavity was limited to the right posterior horn. The gliosis extended from the extreme end of the conus terminalis to the second cervical segment. The microscopic examination explained satisfactorily the symptoms observed in life.

In this case the disease dated from a strain of the back; three years later there were severe pains in the legs, a band-like pain about the lower part of the chest, weakness in the lower limbs, and a spastic gait. Complete paraplegia with contractures, more marked on the right side, wasting of the lower limbs, paralysis of bladder and rectum developed later. Cutaneous sensibility was lost in the legs and upon the trunk as high as the nipple on the right side and a little above the umbilicus on the left. The sense of temperature was absolutely lost over the right arm, the right shoulder, and the right side of the neck, and also upon the adjacent part of the right side of the trunk above the nipple-line. There was some analgesia of the right arm.

It is only in exceptional cases that pressure is exerted laterally, and, on account of interference with the functions of the crossed pyramidal tracts, that spastic phenomena develop.

Marked atrophy is an indication of excavation of the anterior horns, and

its seat, whether in the upper or lower extremities, is an index of the vertical extent of the lesion. In advanced cases the lesion passes beyond the cervical cord and involves the medulla. This is made evident by difficulties of speech and deglutition, and even mental degeneration and other symptoms of bulbar disease arising from disturbances of innervation of the glossopharyngeal, hypoglossal, pneumogastric, and spinal accessory nerves. When the nerves themselves are affected, we may have the evidences of neuritis.¹

The contents of the cavity vary considerably in color and consistence. In some cases the liquid is clear, analogous to the cerebro-spinal fluid; in other cases it may be described as a hyaline jelly perfectly clear or of a turbid or yellowish-brown hue. It may be bloody, thick, and viscid, or contain gelatinous flakes. It never ruptures outward, as it is not subject to any very great internal pressure.

The walls of the cavity are smooth and glossy as a rule, but in exceptional cases are rough, shreddy and uneven, and of a slightly yellowish color.

The new formation, which is the starting point of syringomyelia, is gliomatous. This may be defined as a neoplastic hyperplasia of the gray matter,—a glioma. It has been called by Cornil and Ranvier a neurogliar sarcoma. According to Joffroy and Achard, Hallopeau and Erckholt, after an inflammatory hyperplasia or myelitis a cavity forms from the retraction of the sclerosed periependymal tissue from the distinctive tendency of the hyperplasia, or may arise from softening consequent on thrombosis of the inflamed vessels. Considerable stress is laid on the vascular origin of the cavity, some authors, such as Langhans, Stadelmann, and Steudener, asserting that the cavity results from periependymal œdema, or from hemorrhage with secondary absorption, or from colloid degeneration of the vessels.

Joffroy and Achard's term, *myélite cavitaire*, is entirely reconcilable with the views held by Simon, Westphal, Roth, Blocq, and Schultze, that the syringomyelia is due to a degeneration of the elements of a neoplasm,—a glioma. The differences of opinion are rather discrepancies of terminology. It may be said briefly that the usual course of arteritis in syphilis and in disseminated sclerosis is towards a diffuse sclerosis and not to cavities. We do not meet with cavities in the system sclerosis. The argument, however, that syringomyelia does not result from a myelitis or a central softening of the cord by endarteritis because we do not meet with syringomyelic cavities in the sclerosis of the cord has been shown by Dr. Byrom Bramwell to be unfounded.

The glioma has its seat in the gray substance, particularly the periependymal region, and affects chiefly the gelatinous substance of Rolando,

¹ See Alexis Thomson's case for neuritis of the suprascapular and circumflex nerves, Edinburgh Hospital Reports, 1894.

which acts as an intercellular cement on the gray matter. It is of a yellowish-brown color and of a rather firm consistence. The latest teaching of the French school is that this mass is the result principally of an agglomeration of large cells, which are more or less crowded together, sending out ramifications which by their interlacing enclose small spaces. The cells themselves form small masses of protoplasm, which are grouped centrally or peripherally, and stain conspicuously the ordinary reagents. The trabeculæ are long and delicate, slightly thickened at certain points. In the net-work of filaments the granular elements are enclosed as well as free cells and fine fibres, together with numerous pigment granules, which give the growth a distinctive color. The reticular tissue is well supplied with capillaries.

The cavity is in most cases lined by a thin membrane, which to the naked eye is glossy and of a yellowish hue. It consists of a delicate membrane of neuroglial tissue composed of branching neuroglia cells of various sizes and with small spheroidal and oval cells embraced in a net-work of fibres. These elements may be either densely packed together or loosely arranged. In other cases the cavity has no limiting membrane or we may have such a membrane present in one portion of the cavity but absent at other portions. The process of liquefaction readily takes place in the limiting membrane. Small holes are sometimes observed in the wall,—spheroidal cavities which have been evidently produced by liquefactive degeneration with disappearance of the neuroglia cells. Van Gieson shows that these changes in the glia-cells are not caused by the action of the hardening agents, since the degenerating cells are not scattered uniformly throughout the cord, but are noticeable wherever there is much hyperplasia of neuroglial tissue.

In a typical case the tumor is composed of closely-packed masses of spindle-shaped and oval cells associated with filaments arranged in strands between and around numerous blood-vessels which are surrounded by a close-textured, sparingly nucleated sheath of neuroglia filaments. The cells, when isolated, comprise glia-cells, together with granular, rounded, or spindle-shaped non-branching cells, resembling the cells of sarcomata. The liquefying product will be found to consist of fluid, fibrin, hæmatogenous pigment, and, in places, of disintegrated tumor cells. Liquefactive degeneration of the glia-cells, gliomatous tumors, constitutes one of the characteristic features of syringomyelia. In a given case we may find obliteration of the central canal; at the same time no gliomatous cavity has taken the place of the normal one. While the canal does not exist, we find in its place the remains of its columnar epithelial cells broken down in a coagulation necrosis with a loss of their characteristic columnar appearance. At other levels the fully-formed cavity will be observed.

It should be borne in mind that not every change visible under the microscope was actually present in life. Irregularities of outline, for example, are very often due to the manipulation of the cord in the process of

removal and subsequent examination. Too much stress should, therefore, not be placed on such distortions. The case of Gyurman has been cited by Van Gieson as one of these examples of artefacts mistaken in some respects for pathological change. Dr. Byrom Bramwell¹ has shown by microscopic sections from two ordinary cases of myelitis that cavity-formation with a surrounding dense membrane does occur, but that specimens of central gliosis from another case, which he very carefully prepared, show that the cavity was formed by breaking down in the process of preparation.

Symptomatology.—The symptomatology of syringomyelia has been placed upon an established basis during only the last fifteen years. Previous to that period the clinical symptoms had not been grouped and classified and given their proper value so as to be of any service to the clinician in recognizing the disease. Its identity, judging it by a series of *post-mortem* records, has been established by a system of *a posteriori* reasoning, so that we are in possession of a definite train of symptoms that have enabled the clinician to declare, in turn, the pathological changes which are present in a given case, particularly if the clinical symptoms are well marked.

These symptoms arrange themselves as follows:

I. Intrinsic symptoms.

1. Symptoms of anterior poliomyelitis, and motor symptoms (atrophy).
2. Symptoms of median poliomyelitis (the central gray substance of the cord).
 - (1) Trophic disorders.
 - (2) Deviations of the spinal column.
 - (3) Vasomotor disturbances.
 - (4) Disorder of the sphincters.
 - (5) Ocular symptoms.
 - (6) Bulbar symptoms.
3. Symptoms of posterior poliomyelitis.

II. Extrinsic symptoms.

1. Sclerosis of the lateral columns. Spastic phenomena.
2. Sclerosis of the posterior columns. Tabetic phenomena.

By means of this convenient classification, which we owe to the late Professor Charcot, we may study the symptoms in order.

I. The intrinsic symptoms are related to the gray substance itself.

1. Degeneration of the cells of the anterior horns manifests itself by muscular atrophy. This feature of syringomyelia is rarely absent, and is almost as characteristic as disturbance of sensation. Atrophy was one of the first of the clinical symptoms that appeared prominently in a review of those cases in which an autopsy revealed syringomyelia. Indeed, many of these cases had been diagnosticated as progressive muscular atrophy.²

¹ Medico-Chirurgical Transactions, Edinburgh, 1893-94.

² Examples are found in the cases of Gull, Clarke, Beevor, Westphal, Kahler and Pick, Schultze, Dreschfeld, and Schüppel.

The most frequent form of atrophy is of the type Aran-Duchenne. The small muscles of the hand, the interossei, the thenar and hypothenar eminences, appear to be the regions most frequently involved. The atrophy invades the forearm and the arm, the muscles of the shoulder-girdle and trunk, occasionally involving a portion of the tongue, almost always sparing the face.

FIG. 13.



A case of syringomyelia, showing atrophy. (From the Philadelphia Hospital.)

Whether general or unilateral, the atrophy in these cases is always of spinal origin, and by a knowledge of spinal localization we are enabled by the initial motor symptoms and by their progress to determine very closely the seat of lesion. Valuable charts have been prepared and published by Dr. M. Allen Starr and Dr. C. K. Mills as guides in spinal localization.

They have been made from data drawn from studies in comparative anatomy, physiological experiment, and records of spinal-cord diseases, especially from the study of anterior poliomyelitis, transverse myelitis, and syringomyelia.

The muscles of the lower extremity are not involved by any means as frequently as those of the upper limb. Paraplegia is, however, not a rare symptom.¹

The gait is frequently much disturbed. It is slow and in extreme cases so uncertain that it has been mistaken for that of intoxication. Particularly is this the case when the white matter of the cord is affected, where tabetic or spastic symptoms have supervened. If, in addition, the medulla has been involved with consequent thickness of speech it is evident that unfortunate mistakes of this kind would occur. Such have been recorded by Hoffmann, Raichline, F. Taylor, and Haumann.

Electrical Reactions.—The atrophied muscles are prone to undergo quantitative and qualitative changes in their electrical reactions. The opinion is now becoming more common² that the sign of reaction of degeneration has lost much of the diagnostic value which we have for a long time accorded it, inasmuch as it is met with in affections that are purely muscular, as, for example, pseudo-hypertrophic muscular paralysis, and as, on the other hand, we note its absence in nervous amyotrophies of advanced type. In syringomyelia there is great diversity in this respect in different cases. In the one hundred and eighteen cases which we have analyzed the reaction of degeneration in the atrophied muscles was recorded in twenty-one cases. While no doubt many cases were not examined in this regard, we may safely say that R. D. is not found by any means so frequently in syringomyelia as in atrophy consequent on neuritis. It is quite common, however, to find quantitative changes in syringomyelia, there being diminution and sometimes total disappearance of electrical excitability. In one of Müller's cases the muscles presented a normal appearance apparently in no way atrophic, and yet there was very great diminution of faradic and galvanic excitability.

Schlesinger and Frankl Hochwart have called attention to a case which was under treatment by direct applications of the faradic current to the biceps, exhibiting a peculiar undulation in that muscle when stimulated, and which continued to show this phenomenon during the entire course of treatment.

Fibrillary Tremors.—The affected muscles also present another phenomenon,—viz., fibrillary twitching or tremor. True tremors, as observed in paralysis agitans and in hysteria, are not observed in syringomyelia, but we find frequent mention of a frequent and intense fibrillary twitching. In our analysis of one hundred and eighteen cases this feature is mentioned thirty times.

¹ Cases of Westphal, Schultze, Grasset, Chabanne, and Raichline form exceptions.

² See Guinon's remarks in the *Traité de Médecin*, vol. iii., 1894.

2. Symptoms of median poliomyelitis.

This important group of symptoms embraces those which we seem justified in attributing to an alteration of the central gray substance of the cord. The later continental writers, including Bruhl, have adopted the classification which we give below. While in some respects questions may arise as to the localization of some of the symptoms in this group, with our present knowledge we are not able to definitely relegate them elsewhere.

- (1) Trophic disturbances.
- (2) Deviations of the spinal column.
- (3) Vasomotor disorders.
- (4) Affections of the sphincters.
- (5) Oculo-pupillary changes.
- (6) Bulbar symptoms.
- (1) The trophic disorders of syringomyelia affect four tissues, viz.,—
 - (a) The skin and mucous membranes.
 - (b) The subcutaneous cellular tissue.
 - (c) The joints.
 - (d) The bones.

(a) Trophic alterations of the skin are commonly observed in syringomyelia, and may be of all grades, from a slight glossy condition to extensive necrosis or gangrene. These changes are usually confined to the extremities affecting the atrophied structures, and are prone to occur in the anæsthetic regions: occasionally there is a tendency to hypertrophy of the skin with formation of dense fibrous tissue (Case CXII.).¹ It is common to observe scaling, cracking, and the formation of deep fissures that are the seat of ulcers that become chronic and refuse to heal. These cracks are commonly seated in the palm of the hand, and, although the fissures themselves are frequently painless, the chronic ulcerations are so unsightly that they are often the occasion of the patient's presenting himself for treatment. These cracks furnish a ready pathway for infection, and particularly in syringomyelia of Morvan's type they lead to actual deformity. The accompanying plate from a case of H. Curschmann's illustrates very well this condition. The nails become striated, crack, and suppurate at the matrix. As seen in the plate, some have fallen off, and the remaining stumps with their horny appendages present a repulsive appearance. The resemblance between the observed trophic disorders of the skin and scleroderma are not uncommonly noted by observers. Syringomyelia has been mistaken for pemphigus, on account of the spontaneous bullæ or phlyctenules that are liable to occur on the hands and feet. These phenomena are liable to be persistent, and to give rise to obstinate ulcerations that are difficult to heal, and show a tendency to spread. In a case of Neuberger's there were as many as thirty separate areas of ulceration, of irregular outline and varying

¹ Verhoogen and Vandervelden's case, in which a cavity was found independent of the spinal canal.

size all over the body. Besides this, there were pigmented areas in places, and radiating cicatrices in other situations. In this case there was a syphilitic history, but the autopsy showed a syringomyelia. The mucous membrane of the mouth had been so extensively involved that speech was disturbed, the small vesicles which appeared along the right border and tip

FIG. 14.



Trophic changes in syringomyelia.

of the tongue ruptured and left small ulcerated areas that were extremely painful, and rendered impossible the ingestion of solid food. These patches were at first of circular outline, and covered with a yellowish deposit and surrounded by a reddened areola, but after a time they tended to become confluent. At a later period the left border of the tongue also became affected. In a little while the entire organ became enormously swollen. In the intervals between the paroxysms ulceration sometimes took place in the fissures present. At the time of the attacks there were also pricking sensations in the face. Sometimes the tonsils were swollen and the seat of a yellowish deposit. The condition affecting the mucous membrane of the mouth and pharynx was believed to be pemphigus, non-syphilitic in character. On one occasion an eruption of vesicles was observed upon the extensor aspect of the right hand, and on another occasion a similar eruption on the middle toe of the left foot. Upon post-mortem examination the tongue was found swollen, fissured, and ulcerated. The epiglottis was enlarged and reddened. The entrance to the larynx was closed by intense œdema of the ventricular bands. The mucous membrane

of the larynx was thick and rugous, in places eroded, and here and there, particularly upon the arytenoid cartilages, presenting frothy, yellowish secretions, probably derived from the rupture of pre-existing vesicles. The mucous membrane of the trachea was hyperæmic, swollen, and covered with frothy secretion.

(b) The subcutaneous cellular tissue undergoes well-marked trophic changes. One type of syringomyelia (that of Morvan) is distinguished by painless panaritias, whitlows, or felons. These appearances are usually associated with the palmar cutaneous fissures previously referred to.

There are phlegmons and abscesses, more or less extensive, seated in the arms, the axillæ, and the palms of the hands. Perforating ulcer may also develop. In a case of Le Fort's, in which panaris had existed, and small swellings like boils had appeared on the forearm, shoulder, and abdominal walls, gangrenous areas appeared in the external and upper portion of the left forearm and on the posterior and outer part of the shoulder.

All these trophic lesions of subcutaneous tissues are often serious, if not by their extent, at least by their refusal to heal. They almost always leave behind permanent cicatrices and more or less deformity or mutilation.

Wherever trophic disturbances like panaris occur there is occasionally a subjective sense of cold; in other cases the skin assumes a cyanotic hue or, on the other hand, a diffused redness of the skin with sense of burning. In these cases the surface temperature is sensibly elevated, and a surface thermometer may record from 7° to 9° C. more than when normal areas are tested.

Neuropathic œdema may occur in a generalized manner or localized in a single part, as, for example, in the dorsum of the hand. In one of Verhoogen and Vandervelden's cases (No. 6) there was a cyanotic œdema of the ankles when the patient assumed the erect position.

Roth has described cases with "tumeurs pateuses" which are examples of neuropathic œdema seated in the connective tissue. They presented pitting on pressure and were not associated with any discoloration of the skin.

(c) *Arthropathy*.—Just as in tabes so in syringomyelia, it is not unusual to find affections of the joints. Indeed, they occur rather more frequently than in locomotor ataxia. In our analysis of one hundred and eighteen cases we find arthropathies in thirty-eight or thirty-two per cent. of cases. They may occur spontaneously without trauma, appearing suddenly without accompanying fever or pain. The shoulder- and elbow-joints are favorite sites in this respect, affording a contrast to tabetic arthropathy in which in about seventy-five per cent. of cases we find the lower extremities involved. The syringomyelic arthropathies are usually seated in the upper extremities. It is liable to occur at an early stage, and taken in connection with sensory disturbances constitutes an important and early sign of the disease.

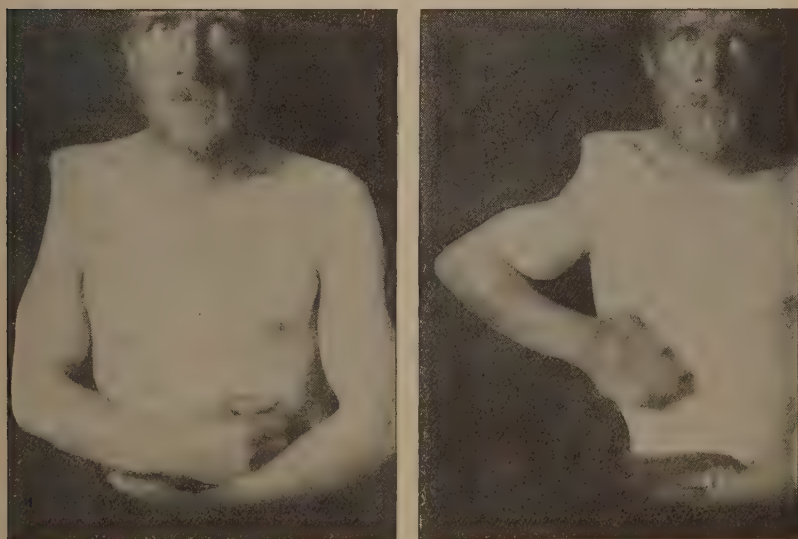
In Schlesinger's ninety-seven cases of syringomyelia with arthropathy we have the following distribution :

SCHLESINGER'S CASES.

Shoulder-joint.	29
Elbow-joint	24
Wrist-joint	18
Thumb	2
Hip	4
Knee	7
Ankle	7
Jaw	4
Sterno-clavicular	2
Total	97

The arthropathy may consist of a simple hydrarthrosis. The joint swells and leads the patient to consult a surgeon, sometimes, rather than a physician. It is not generally painful, and may become quite aggravated without the patient being aware of it. There may be a subsidence for a time and then an increase of deformity. After swelling of the joint and subsequent disappearance of the fluid the articulation is loosened by re-

FIG. 15.



Arthropathy of the shoulder in syringomyelia. (Alexis Thomson.)

laxation of the ligaments, and it is quite easy to produce luxation. The epiphyses become friable; spontaneous luxation may occur with the growth of enormous osteophytes. Motion at this stage is accompanied by crackling sounds, but the movements are not, as a rule, painful to the patient.

In a characteristic case which had been under observation for years in the Philadelphia Hospital, and studied by Dr. Dercum and others, the right shoulder-joint began to swell, and from rupture of the capsular lig-

ament cellulitis with redness and local heat was produced, but with little or no pain. In extension the humerus assumed the position of a subglenoid luxation. Death was due to exhaustion.

At the autopsy, in 1896, the capsule of the right shoulder-joint was found much thickened and roughened on the inner surface. The head of the humerus had disappeared, the bone having been eroded to some little distance below the surgical neck. A cystic tumor was found in the axilla containing a friable fatty material. The surface of the glenoid cavity was much eroded, roughened, and porous; it was abnormally large, and extensive bony deposits had taken place along its edges. The coracoid process exhibited a thick and firm accretion around its entire edge.¹

Shoulder-joints have even been excised² without the use of an anæsthetic, and in one instance the patient himself occasionally used to evacuate fluid from his elbow with a pair of scissors. A typical case of this kind has been recently published in full by Mons. J. B. Charcot. The patient, a female, aged fifty-seven, had furnished a characteristic picture of syringomyelia, in which the left upper extremity was the seat of the dissociation symptom. The right arm and forearm retained feebly their sensation. Scoliosis and lordosis were marked. In the course of time this patient left the hospital, and three years after the publication of Critzman's account of the case it came again under observation. It transpired that in 1892 she had a fall, first striking the left atrophied shoulder and then the right shoulder, which was the better and which was only slightly disturbed as to sensation. She continued to use her arm, but not so well as before, but at the end of three weeks it had swollen considerably and movement was more difficult. The right shoulder-joint was the seat of an effusion and half a litre of fluid was drawn by aspiration. A luxation received at the time of the fall was then easily reduced, but recurred, and crackling sounds of the joint were noted. The head of the humerus became atrophied and deformed, so much so that dislocation could be produced at will in all directions. Pain had never been very noticeable in this joint; it was present at times, especially under manipulation, but was transient and easily borne. It was particularly the crackling which disturbed and irritated the patient.

(To be continued.)

¹ For description of pathological changes in the spinal cord, see page 627.

² Sokoloff's case and Czerny's case.

CONGENITAL NARROWING OF THE MITRAL ORIFICE
AS A CAUSE OF DWARFED LIVES AND
IRRITABLE HEART.

BY ROLAND G. CURTIN, A.M., M.D., PH.D.,
Philadelphia.

MR. PRESIDENT AND GENTLEMEN,—I wish to bring to your notice a condition of the heart which I think has hitherto been undescribed. The number of cases that I have seen would indicate that it is not a very rare condition, as I have seen about one hundred sufficiently well marked to be recognized. These have been culled from over thirty thousand distinctly medical patients seen in a large dispensary and hospital service, as well as in a private and consulting practice, which includes many heart cases.

While I was serving as chief of the Medical Dispensary of the University of Pennsylvania, in 1877, a young woman presented herself with blue lips and extremities, and was regarded as a case of vasomotor and trophic affection of the fingers. She had the murmur and physical signs, to be hereafter described, in a marked degree.¹

One year later, about Christmas, 1878, three boys presented themselves in a single week at the same dispensary with similar physical signs and symptoms. They were from a prominent city store. They had been acting in the capacity of "cash boys," and the unusual activity, running up stairs, etc., consequent upon the extra hours incident to the holiday shopping, caused them to break down and apply for treatment. In all of them the symptoms were rapid, irritable hearts, suffused faces, shortness of breath, a murmur over the heart, and loss of strength and appetite.

On inquiry, I found that they had previously lived very quiet lives, without active exercise. They were easily fatigued, unable to keep up sustained action, and even in early childhood had been unable to cope with their fellows in active play. They had lived sedentary lives and took only very little exercise.

These cases aroused my curiosity. I have been studying their counterparts with increased interest ever since. I now give you the results of my work. I will read the histories of a few of the cases which best illustrate the early history, symptoms, and physical signs.

CASE I.—*A Marked Case of Dwarfed Life without Irritable Heart.*—E. V., seven years old. Never, from his earliest childhood, had he played

¹ Case reported in the October number of the American Journal of the Medical Sciences for 1878, by Dr. C. K. Mills.

with or like other boys. He never had any marked symptoms until he was fourteen years old. Since then he has grown rapidly. He has had no disease except the usual diseases of childhood. At seventeen he had measles and lung complication.

He is now in college. I asked him whether he played foot-ball. He answered, "That is too rough." I then inquired whether he played base-ball. He said, "That is too active." Next I asked whether he played lawn-tennis, and he replied, "That is too rapid for me." So I finally inquired what he did for amusement. He said, "I play the piano, read, do fancy needle-work, and write poetry." He graduated from college, read law, practised a year and a half, and finally took up office literary work, in which he is eminently successful.

He complains of a pain as if a nail were driven into the sternum opposite the cartilages of the second rib. He complains also of dizziness, and at times loss of memory, and has what is called a "cramped brain," especially on dull days. His growth is good, but he is poorly developed and his muscles are flabby. A marked pulsation at the second upper interspace. The location of murmur one inch above and to the outer side of the nipple, which was on the fourth rib.

CASE II.—*A very Mild Case, with Irritable Heart developed by Strain.*—Wm. L., thirty years old; salesman. While playing ball, at the age of fifteen years, he was running for the "home plate," when he became suddenly weak, and his heart began to palpitate and seemed to be "running away." He stopped and sat down, and in fifteen minutes the heart as suddenly stopped palpitating. The tachycardia has continued during the last fifteen years to return on the slightest provocation, such as coughing spells, active exercise, prolonged work, dyspeptic attacks, cold, etc. Smoking has a bad effect on his heart.

On November 29, 1890, he had an "influenzal cold," with sore throat, soreness of the chest, and some fever and catarrh. He had also palpitation, rapid pulse, pallor, sweating, and frequent vomiting. His heart jumped and fluttered; he had a dull ache at left apex. He has had half a dozen spells of palpitation. Pulse was rapid and heart laboring.

There was a slight pulsation at second left interspace and a vague murmur above left nipple. Dulness on percussion at left apex anteriorly.

CASE III.—S. M., fifty-two years old. Could not run with other boys, and was not strong enough to cope with his playmates. As a child, any exertion brought on shortness of breath and a "hard beating of the heart;" but he could walk all day, and would outwalk those who could run and beat him at other violent exercises. He had night-sweats twenty years ago; a cough for five years; spat blood two years ago. Pulsation at second interspace; murmur at third interspace, which was distinctly heard just above the left nipple.

CASE IV.—E. G., thirty-six years old; married; mother of eight children. Her labors have been easy, without unusual symptoms. Has never

had rheumatism. "She was always a 'quiet child,'" her family said; "always tired after work, and when very much exhausted her lips were blue. She was a chronic dyspeptic."

Last September she had night-sweats. She had a slight hemorrhage last week; presystolic murmur at third interspace in the nipple towards apex of left lung. The apex of the left lung was found to have the following physical signs: resonance, expansion, and vesicular murmur were diminished.

CASE V.—*A very Slight Constriction, with Symptoms of Irritable Heart and Disturbed Circulation, developed by Overwork and Severe Athletic Strain.*—J. T., twenty-five years old, came to me with an irritable heart. He gave the following history:

He worked at the gas-works, and when not employed rowed on the Schuylkill River with a boat club. He began training in a crew for a boat race, but soon "trained off," and applied to me for treatment. I found him with red, turgid skin, blood-shot eyes, general trembling of head and extremities, with hæmoptysis, a rapid heart and respiration. Upon examination, I found a diffused murmur in the usual place over the nipple and an auricular impulse.

After a month's rest all the symptoms and physical signs subsided, to return in a milder form upon active exercise or long-continued labor.

This was not a very marked case, until the unusual and prolonged athletic exercise developed the symptoms which led to the examination of his chest.

CASE VI.—M. E., twenty-six years old. His father had a dwarfed life, and had what was diagnosticated to be a congenital disease of the heart, he manifesting cyanosis when the weather was damp and cold. He died about middle life with exhaustion, cyanosis, and great dyspnœa.

The patient has always played with girls, making "mud-pies," and taking part in other quiet games. He never could stand the racket made by boys.

From earliest childhood exercise has been followed by a thumping of the heart; and if continued after this he would have dyspepsia, a sick headache, and then he would take a long, enforced rest from nervous prostration. He must have nine hours' sleep and a sleep or nap during the day, in order to keep from feeling tired and good-for-nothing.

Four years ago he broke down while preparing for college, and had to stop. I advised him then to go to the sea-shore and lead a quiet, restful life. He is now, after two years, quite fleshy, and has perfect health so long as he leads a quiet, peaceful life.

Murmur above nipple only on exertion now (1896). No auricular impulse, which was present four years ago.

Pulmonary second sound accentuated.

He has had hæmoptysis several times.

Two weeks ago this case came into my office, and I took him to see Pro-

fessor J. M. Da Costa. After a careful examination the latter failed to discover a murmur. I then made the patient go rapidly up and down the office three times. After the exercise Dr. Da Costa readily found a marked murmur in the usual position above the nipple, as indicated in my paper. The murmur was a short, loud whiff with the carotid pulse, seeming to commence and stop with it. Dr. Da Costa said that the case was to him a novel one. He also said that he would consider the murmur a systolic one as to time. There was a pronounced accentuation of the pulmonary sound. There was no pulsation at the second interspace over the auricle, as was found at a previous examination two years before, when his heart was excited.

You will observe that the foregoing cases can be easily grouped into a class, not only by their histories, but also by their symptoms and physical signs. I will call your attention to some of the important points. You will please notice the tendency in some of the cases to lung and pleural trouble of a chronic form, with hæmoptysis and night-sweats. The lesions of the lungs and pleura were generally in the left side. More than one writer has called attention to the comparative frequency of left-sided trouble of the lungs and pleura and hæmoptysis in mitral constrictive disease. In the severer cases the auricular pulsation was decidedly marked. The location of the murmur is so far from the usual point where murmurs are looked for that it might be overlooked. The murmur was almost always absent when the circulation was quiet and there was no consolidation of the lung to transmit it. The point of greatest intensity was above or to the left of the nipple in the third interspace, the time of the murmur pre-systolic or early in the systole. The murmur was not transmitted, being quite localized, except when conveyed by a consolidated lung in contact with the heart wall. The accentuation of the second sound over the pulmonary valves was present to a greater or less extent in almost all the cases, more especially when the heart was excited. The excitement of the heart was brought on by prolonged labor, strain, dyspepsia, fever, influenza, etc.

The patients were never wild, active, romping girls or boys, but quiet and inactive, being easily fatigued. Some shrewd diagnosticians have examined some of these cases and pronounced them free from murmur, even while the heart was excited and the murmur present, having overlooked the murmur on account of its position.

The marked cases have been mostly, about ten to one, boys or growing men. Perhaps this proportion is due to the fact that they are encouraged to greater activity in play or work than are females. I have picked up a number of cases by the casual remark of a mother that one of her children was so quiet, would not play as the others did, but would sit around and read, or engage in some pastime that required no exertion.

One case was that of a young woman, nineteen years old, who nearly died while being delivered of her first child. She suddenly became cyanosed and collapsed. She was only saved by rapidly delivering her with instruments, thus preventing any further bearing-down effects.

Most of the cases applied for treatment on account of symptoms of irritable heart, and the majority of the remainder were recognized by the history of the dwarfed life, and then by active movement developing the murmur. The murmur was almost always inaudible when the heart was quiet, but vigorous exercise would immediately develop it. The murmur was presystolic, or with the first part of the systole, at the top mitral area, or immediately above, or above and to the outer side of the left nipple, and generally associated with an auricular impulse.

In all the cases where the disease was well marked hypertrophy of the left auricle was present, as shown by pulsation in the second left interspace.

The symptoms are those of a laboring heart, emaciation, a dark, muddy or blue complexion, soft muscles, relaxed skin, and a general want of enthusiasm for anything that requires activity, for activity soon begets weakness, dyspnoea, tachycardia, and exhaustion. When exhaustion occurs a long time is required to recuperate the strength.

Post Mortem.—The disease being one that is not fatal, the large proportion of the cases are still living; consequently post mortems have been few. I have had three opportunities of having examinations made after death. All were attended with negative results, so far as the size of the mitral orifice was concerned. The difficulties were that no one was able to state exactly how large the mitral orifice should be in a given-sized heart. One pathologist measured the orifice with his three fingers arranged side by side (000), another placed his three fingers closely together, one on top of the other two (00), and the third one measured it with a cone. All were said to be of normal size. They all exhibited a healthy condition of the endocardium, which would assist in the supposition that they were healthy. Again, the left auricles were all hypertrophied and dilated, which gave the heart the appearance of being larger than normal, while the left ventricles were rather small.

Who can answer the question, How large should the mitral orifice be in the heart of given size or weight?

I do not think that the constriction should be great to produce the symptoms herein described; for, while the blood-current is slow, it is large enough to allow the blood to pass without a murmur, but when the blood runs faster and is in larger bulk the murmur then appears, but during the interval no murmur is discoverable.

Prognosis.—The mild cases are long-lived, unless some accidental disease cuts the patient down, as pneumonia, endocarditis, chronic phthisis, œdema of the lungs from Bright's disease, or some other disease not well borne when accompanied by a crippled circulation.

Strains during the period of active growth are serious, in that the lungs become congested from the stasis produced by the interference of the blood-current. If this is frequent or long-continued, it results in chronic congestion, degeneration, or a sudden airless, œdematous condition of the lung, called by the old writers carnification.

In the young the disease sometimes seems to become milder as development and growth take place, especially about puberty.

If the affection is severe, the patients generally die before middle life; but if it is slight and they are careful, they may live to quite an advanced age with comparative comfort and usefulness.

Treatment.—It is of vital importance that this condition should be recognized early, as by proper advice as to mode of life, occupation, etc., a life may be prolonged and made useful. An active business with long hours will be surely followed by serious results. The orifice being unable to transmit enough blood to supply the body without effort, this effort ultimately wearies or excites the heart.

In addition to this, the blood is backed on the lungs, producing congestion, which, when very marked or when frequent, is followed by chronic degeneration.

All active pursuits and long hours must be interdicted. Direct the business to the capacity of the patient, varying with the degree of the disease. Correct all errors of diet, as an attack of dyspepsia will often bring on an attack of heart excitement. Avoid exposure to cold and dampness. Guard against anger and mental anxiety or excitement. Stop all venereal excesses. Tell them always to live like old people. Banish anything that would be likely to bring on diseases, especially of the heart, lungs, blood, or nervous system. If the heart is excited administer belladonna, assafoetida, the bromides, camphor, valerianate of zinc, or any nervous sedative. The congestive and chronic lung trouble should be treated according to the usual rules.

Overwork or long hours tell on the strength slowly or rapidly, and if the disease is even slight we have a loss of flesh and strength, with occasional palpitation.

If the work is very active, the irritable heart may be the first symptom. When the symptoms are noticed the patient should be *put to bed without electricity and massage*, and should subsequently stay in bed eight or ten hours at night, and in the middle of the day should lie down.

Conclusions as to Lesions.—The reasons for considering it a constriction of the mitral orifice:

1. The chronic congestive lung trouble found associated with this condition.
2. The chronic lung-disease almost always found on the *left* side.
3. The venous stasis and weak arterial circulation.
4. The character of the murmur. It is presystolic, mitral, or with the early part of the first sound.
5. The location of the murmur. It is over the left border of the heart, about the location of the mitral orifice.
6. The loudness of the murmur would indicate that it required the force of the blood-current only found in the left side of the heart.

7. It is a sharp, short, whiffy murmur, which sounds quite near to the chest wall.

8. It is never transmitted, except when the lung is consolidated.

9. The symptoms generally tally with cases having acquired mitral stenosis of a mild character.

10. The hypertrophy of the left auricle, which almost always accompanies mitral obstructive disease.

11. The accentuation of the pulmonary second sound ; for, if we have constriction of the mitral orifice, the stopping of the current of the blood, when hurried, dams the blood backward, causing a sudden shutting down of the pulmonary valve and causing the pulmonary second sound to be accentuated.

Reasons for believing that it is congenital :

1. The symptoms all date back to early childhood.

2. It is unassociated with regurgitant disease, which is the most frequent form of heart-disease from endocarditis, and so often associated with mitral constriction.

3. The murmur is generally inaudible when the heart is in a quiescent state.

4. Under a favoring life it does not progress as old inflammatory conditions usually do.

5. It seems to be hereditary,—*e.g.*, a mother and her daughter, two children in the same family, and a father and son.

6. The deficiency of development and growth from early life in most of the extreme cases.

7. On post-mortem examination, in neither case was any change, indicating either present or previous inflammation, found in the endocardium about the valve or orifice.

8. The absence of previous disease that would be likely to produce endocardial inflammation.

In conclusion, I would ask you to test your weak and quiet patients by a rapid run, followed by the application of the ear above and outside of the left nipple, and I am sure that you will sometimes be surprised.

Perhaps some of the evanescent murmurs described by various authors may be of the kind I have presented to you in this paper ; for sometimes in lying down the murmur is lost, and on rising it is found.

I am satisfied that if marked cases of the affection under discussion should be called out as soldiers, requiring prolonged, exhausting marches, into any sudden activity, an irritable heart could be produced.

In reading this paper I feel that I am right in my conclusions. If I am wrong, and your interest is attracted to this class of cases and a positive solution is discovered, I will feel that my labor has not been lost. My only query would be, Why should this murmur be so much higher than in the ordinary cases of inflammatory, mitral stenosis, and why should it sometimes occur after the presystolic period ?

CASE OF RATTLESNAKE-BITE: RECOVERY AFTER CONTINUOUS APPLICATION OF A TOURNIQUET FOR TWELVE HOURS.

BY WILLIAM W. ASHHURST, M.D.,

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APOLINAR T., Mexican, male, fourteen years of age, was bitten on the right ring-finger by a small rattlesnake at about 7 A.M., July 16, 1896. A few minutes after the occurrence of the accident, some member of the family applied a "Spanish windlass" ligature to the arm just below the axilla. This remained in position about twelve hours, when it was removed by a physician.

The patient was first seen by me on the morning of July 17, more than twenty-four hours after the accident. I found him in a condition of profound depression. Neither the radial nor the axillary pulse of the affected arm could be felt at all, owing to the great swelling of the limb, and the pulse of the left radial artery was so weak that it was almost impossible to count it. The right arm was enormously swollen, and the skin of a brawny consistence. The injured finger did not seem more swollen than the others of the same hand. A shrill systolic murmur was perceptible over the aortic cartilage, probably of hæmic origin.

As the arm was warm, and there was present some feeble capillary circulation in the fingers, I concluded, in order to soothe the intense pain of which the patient complained, to try the effect of a cooling lotion, ordering therefore, locally, lint soaked in lead-water and laudanum, to be renewed every hour, and internally, alcohol, carbonate of ammonium, digitalis, and nux vomica, with liquid diet, and with rest in the recumbent posture strictly enforced.

On account of the length of time that had elapsed since the injury, I deemed it useless to apply any local antidote, believing the poison to be already thoroughly distributed through the arm; and at the same time it seemed most probable that, on account of the feebleness of the circulation in the injured limb, the poison would enter the general circulation very slowly, thereby rendering further application of the tourniquet not only dangerous but useless.

By evening the pulse was stronger, and the patient expressed himself as greatly comforted by the lead-water and laudanum.

The following day, July 18, the patient's general condition had further improved somewhat, but the œdema had spread to the neck and chest.

By July 19 it had extended downward as far as the crest of the ilium

on the right side, completely around the neck, and across the chest as far as the left axilla. The skin was discolored, purple and blackish in patches over the arm, side, chest, and abdomen. At this time the brawniness of the arm was disappearing, and the radial pulse could be felt. The patient was now put upon Basham's mixture and nux vomica, and continued to improve.

By July 25 all the swelling and discoloration had disappeared, the heart murmur could no longer be detected, and the patient could use the right hand and arm, although they were still somewhat stiff and painful on motion. He was now allowed to get up and go home, and subsequently reported himself, perfectly recovered, on August 21.

CLINICAL LECTURES.

PARAPLEGIA.

GUNSHOT WOUND OF THE SPINAL CORD.

Bullet located by the Röntgen Ray and subsequently extracted—Obstinate Bed-Sores Relieved by Constant Stay in the Water-Bath for Three Months—Case presented at the Good Samaritan Hospital Clinic, October 6, 1896.

WITH REMARKS BY DRS. WHITTAKER, RANSOHOFF, AND KRAMER.

DR. WHITTAKER.—Gentlemen, I present you to-day a case interesting from many stand-points, but especially as illustrating the difficulty of exactly locating a lesion in the spinal cord and the final success with which the new rays have crowned our efforts. I am sure you are all sufficiently familiar with physiology to know that the spinal cord is probably the *terra incognita* of medicine. A great many experiments have been made upon the lower animals, with the result, however, of obtaining as yet but little positive knowledge; so that we can to-day do little more than appeal to the results of the experiments of Charles Bell, which proved that the anterior horns have to do with motion and the posterior horns with sensation. You will study much concerning the cerebral fibres in the cord, much about fibres originating in the cord, and more about decussating fibres; but there is very little positive knowledge, and exceedingly little that can assist diagnosis. It is really almost as easy to locate with exactness a lesion in the brain as in the spinal cord. But this whole field of obscurity has been suddenly illuminated—so far as the localization of a foreign body is concerned—by the new rays of light.

Let us now hear from the interne the history of the case.

Mrs. L. B. Y., aged twenty-two, married, entered the Good Samaritan Hospital July 2, 1896.

History.—Five weeks ago, in careless manipulation of a pistol she received the discharge in the abdomen in the region of the stomach. The patient immediately sank into collapse, vomited blood, but did not become unconscious. It was noticed at once that all the lower part of the body was paralyzed. The patient had also lost all perception of touch or pain below the stomach. The paralysis involved the bladder and bowels, so that the urine had to be withdrawn by the catheter and the bowels washed out by injections. In the course of a few days bed-sores began to develop on points of pressure, and great pain was experienced in the upper half of the body, radiating towards the back and shoulders. Morphine was administered to relieve this pain, and in such increasing doses as to finally beget a habit, so that the patient at the time of entrance is taking ten to twenty grains per day.

Present Condition.—The patient is a nervous, delicate woman, much emaciated, and showing marked atrophy in the lower half of the body. The cicatrix caused by the entering of the bullet is located in the median line, some inches below the ensiform cartilage. Paraplegia is complete and absolute. No reflex can be obtained anywhere. The skin is white and scaly; it has the appearance of rolled-out uncooked pastry. At all points of pressure, over the sacrum, the trochanters, the knees, and the ankles, large and deep bed-sores have developed. These bed-sores extend in many places to the bone, which is partially denuded, the base being covered by a slough. The edges are livid, not indurated, but in some regions clean cut, as if by a large punch.

Diagnosis.—Gunshot wound of the spinal column with pressure upon the cord.

Treatment.—The bed-sores are treated with europhen paste; the bladder is evacuated by a catheter; cascara is prescribed for the constipation; the patient is put upon a water-bed.

July 13.—A skiagraph was attempted with the X-rays, but failed to locate the foreign body.

July 20.—Another attempt with the X-rays by means of a larger Crookes tube succeeded in locating the bullet or a point near it as a clear space in the body of the eighth dorsal vertebra. The patient shows signs of pyæmia. Quinine and whiskey are to be administered freely.

July 21.—The patient anæsthetized was put upon the stomach and face and a long incision made in the lower dorsal region over the spinal column. The arches of the vertebra were divided, and after considerable searching the bullet was found in the eighth dorsal vertebra, embedded in the body of the vertebra, protruding bone into the spinal canal and compressing the spinal cord, which seemed to be considerably broken up. The patient remained very low for a week after the operation, when she began to regain strength. She was during this period stimulated to the limit. The wound healed chiefly by granulation and at no time caused any trouble. The bed-sores, however, persisted.

August 26.—The patient was immersed in a tank of water, which was kept in continual circulation and at a uniform temperature of 90° F. She remained in the tank during the greater part of the twenty-four hours, being removed to a cot for an hour each day. The change effected by this treatment was at once noticed. The appetite began to improve; the general spirits to brighten; the bed-sores to show signs of healing, and the patient to take on flesh and strength, whereupon the quantity of morphine was gradually reduced to four grains in the twenty-four hours.

From our stand-point as clinicians the study of this case is immensely simplified by the history. We are in no wise embarrassed by the etiology.

Ordinarily, the study of disease of the spinal cord is attended with considerable difficulty, but we have here a history of sudden injury to the cord, followed at once by a train of symptoms so characteristic as to leave no doubt of the nature of the lesion.

You have heard in the history of this case that immediately upon the receipt of the injury the patient sank to a state of collapse, that hereupon ensued vomiting, and vomiting of blood. In this collapse the patient was not unconscious, though so sudden and great shock to the cord sometimes extends to the brain and is attended by loss of consciousness. More characteristic is the act of vomiting, which usually sets in after severe damage to the cord; though you are not to infer from this that the stomach has necessarily been subjected to injury, as the act of vomiting in these cases is often reflex. But according to the statement of the physician who saw her immediately after the accident, the patient vomited blood, and the vomiting of blood, I need not say, is best explained by penetration of the stomach wall itself. So soon as the patient was picked up it was seen that the lower half of the body was paralyzed. There was absolute loss of all motion and sensation below the line of the waist. In other words, there was complete paraplegia.

Paraplegia nearly always follows injury to the spinal cord, but by no means necessarily indicates traumatic injury. Sometimes, indeed, the paraplegia is of cerebral origin, but to produce paralysis of both extremities the injuries in the brain would have to be multiple and located in regions where the cerebral fibres from the two hemispheres come together in transit to the cord,—consequently at the pons or medulla.

There are also cases of toxic origin. I showed you a case here last year of perfect paraplegia which was the result of multiple neuritis. I will have occasion now to show you another case in the wards of absolute paraplegia, with no organic lesion whatever in either the brain or cord, caused simply by hysteria. Most of the cases of paraplegia which we see at this age are due to neoplasms and result from lues. But in none of these cases is the paraplegia sudden. In the great majority of cases a sudden paraplegia is of vascular origin,—that is, it is due to rupture of a vessel, and represents apoplexy of the cord. We say sudden, but even here the paraplegia is a development of some hours. In our case the paraplegia was not merely sudden, it was instantaneous, and, as I have said, we need look no further than the history to find the explanation.

We observe therefore, as stated, total abolition of motion and sensation below the seat of the lesion. All the reflexes are also entirely lost. There is no ankle-clonus, no patellar or abdominal reflex; nor in all this region is there any perception of touch, temperature, or pain. The action of the bladder and the bowels was entirely arrested. The urine had to be regularly withdrawn by a catheter and the bowels washed out with injections. But this is not all. The vasomotor system suffers and, above all things in this case, trophic changes are most pronounced. The whole body is, as you see,

considerably emaciated, but the wasting is chiefly in the lower extremities, which have become extremely atrophied.

These trophic changes are at present the worst feature of the case, for the arrest of nutrition is so profound that the slightest pressure produces bed-sores; and you observe here over the trochanters, about the sacrum, at the knee, ankle, indeed at any point which has been subjected to the slightest pressure, great bed-sores; these, when the patient first came to us, extended to the bone and presented sloughing masses varying in size from that of an unhulled hickory-nut to that of the palm of the hand. It was really to alleviate this condition that the patient, despairing of any relief from the paralysis, came to us. These bed-sores proved exceedingly refractory to every kind of treatment, yielding in no way, even when the patient was put upon the water-bed. But they were finally brought under control in the water-bath itself. They have now, as you see, filled up to the level of the skin, but there is not yet sufficient vitality to cover the surface over with cutaneous tissue, and we are unable to keep the patient out of the bath long enough to secure the apposition of skin-grafts.

The question of supreme practical importance in this case hinges upon the exact localization of the foreign body. It would seem to be an easy thing to trace up the region of anæsthesia and draw a line at the beginning of sensation. But the process of localization is by no means so simple, for in the first place the distribution of the nerves of the skin is not uniform, and in the second place the patient's perception is not always the same. Thus sensation is apparently perceived higher at certain times than at others. All the text-books furnish tables indicating the paralysis of motion, sensation, and reflex action at the level of different vertebræ. These lesions are, however, better established in the cervical and lumbar than in the dorsal vertebræ. Thus, in the tables of Edinger and Starr, modified by Leyden and Goldscheider, the segment between the second and twelfth dorsal vertebræ is indicated by paralysis of the muscles of the back and abdomen, loss of sensation of the skin of the chest, back, abdomen, and upper gluteal region, and by loss of the epigastric and abdominal reflex. According to Dinkler, the epigastric reflex ceases with injuries on the level of the ninth dorsal vertebra; the middle and lower abdominal reflex, at the level of the tenth and the twelfth dorsal vertebræ. No reflex action is experienced in our case on irritating the skin in the region of the epigastrium, which would indicate that the lesion lies above the ninth dorsal vertebra. We may not, however, specify this localization with exactness, and as it is a point of supreme importance to damage the delicate tissue of the spinal cord as little as possible, you may understand the value of the Röntgen ray which enabled the operator to determine in this instance nearly the exact site of the lesion.

The Röntgen ray has done a good many curious things in medicine; perhaps the most remarkable is the picture of the *fœtus in utero*.

Varnier, Chapuis, Chauvel, and Funck-Brentano took a photograph of

an unopened uterus hardened in alcohol at three and one-half months' pregnancy. The picture showed the silhouette of the body of the uterus, the varying thickness of the musculature, and the contours of the embryo. The foetal skeleton could be clearly distinguished. The authors believed also that they were able to declare the sex to have been female.

These experimenters took also a picture of a pregnant guinea-pig immediately after death. The four embryos were distinctly recognized in their various positions, the head of one lying in the pelvis.

But even with the Röntgen-ray illumination we would be unable to appreciate the amount of damage done to the cord. Nor could we so exactly determine this fact even at the time of operation. It was impossible to know to what extent the cord was pulpified or damaged. Sometimes in a complete paraplegia from violent concussion of the cord no damage whatever is found upon autopsy; sometimes not even microscopical examination may disclose a lesion. In these cases the alteration is said to be molecular. Something like this is seen in the demagnetization of iron by a blow. There is no appreciable change, but the magnet has lost its peculiar property and is reduced to an inert metallic mass.

Sometimes, of course, the damage is apparent. The effect of trauma in disorganizing the cord is shown in the experiments of Schmaus, who, after concussion of the cord in rabbits, found granular degeneration of the ganglion cells, swelling and destruction of the axis cylinder, especially of the sheath, and occasional spots of softening. The author considers the changes a direct traumatic necrosis of the axis cylinder, due to molecular change and not to rupture. So in most cases depots of softening and formation of vacuoles have been seen as the result of a *commotio spinalis*.

Serious change takes place in the ganglion-cells of the cord under interruption of the circulation, and the symptoms which show themselves after destruction of the gray matter of the cord are well displayed in the experiments of Münzer and Wiener upon rabbits. These observers found that compression of the abdominal aorta for one hour just below the origin of the renal arteries was followed by permanent motor and sensitive paralysis of the posterior extremities and of the bladder and the bowels, and that this paraplegia was due to necrosis of the cells in the gray substance of the lumbar cord. When the animals were killed at the end of an hour the ganglion-cells showed no visible changes, but at a later period the chromatic substance showed molecular change, in that it was broken up into many fine granules, the cells losing the capacity to take up coloring matter. In from one to two days the ganglion-cells could be distinguished only as outlines, in consequence of the homogeneous alteration of their protoplasm. If the cells of the posterior cornua had not been destroyed the sensation of pain still remained, so that the perception of pain, as we shall see, implies intact posterior horns.

Of course, it was clear that no possible benefit could be secured in this case without the removal of the foreign body, and it was also manifest that

the foreign body could not be readily removed without an exact localization of the lesion. I have already remarked upon the difficulties attending this process. We were fortunate in being able to study the case under the Röntgen-ray illumination, and we were additionally fortunate in having with us, among the younger members of our profession, a *wiszbegieriger Junger*, one of my former pupils, who has devoted a good deal of time to the study of the new rays, and whose scientific attainments well qualified him to utilize them in this case and to explain to you the process so far as it is known. I therefore turned this case bodily over to him, and he will tell you how he was enabled to find and extract the bullet; further, to what measures he had recourse to relieve these bed-sores.

DR. KRAMER.—Gentlemen, the discovery of Professor Röntgen seems to be one of great importance to us.

In opening his paper, Röntgen said, if the discharge from a large Ruhmkorff coil be sent through a vacuum-tube (a Crookes's tube, as it is called), and there be in the neighborhood of this a screen of paper covered with barium cyanide, the tube being covered with dark card-board, certain rays will pass out through the card-board and render the screen luminous. Röntgen further found that if he substituted a photographic plate for the screen the silver was reduced, as when exposed to the solar rays. He further found that certain substances might be introduced between the Crookes tube and the plate and the rays would pass through them, but that certain other substances offered more obstruction to the rays, and thus the shadow of all such impenetrable substances would be produced on the plate.

The current from the Ruhmkorff coil is nothing but a current under enormous pressure, that is capable of overcoming very great resistance. The amount of current in the Ruhmkorff coil is, of course, very small. It is very much like putting a bucket of water in a capillary tube a mile high; you would have very little water, but it would be under enormous pressure. The degree of vacuation in the Crookes tube is unknown: it is said to be the one-millionth of an atmosphere. At any rate, there are but very few molecules of air within the tube. These molecules have plenty of space between them, so that they can readily move. Now, the hypothesis is this: The current escapes under enormous pressure, as all currents do, from the positive pole to the negative. The current carries with it these molecules of air.

When these molecules strike the negative-pole, the latter being placed at an angle, they glance off (the angle of incidence being equal to the angle of reflection), strike the glass wall of the tube, and produce here, as in the coming together of flint and steel, a green fluorescence. Now, all of this was known in the seventies, having been demonstrated by Professor Crookes.

Röntgen's discovery was that in addition to these fluorescent rays there was some other form of energy that differed from the ordinary light rays

in that it could pass through certain substances that were opaque to the solar rays. Of course, theoretically speaking, nothing is absolutely opaque to the Röntgen or X-rays. It is the difference of penetrability that enables us to get a picture. Bones, for instance, are much less penetrable than soft parts. Therefore, if we hold up our hand between the Crookes tube and the fluorescent screen, there is thrown on the screen a shadowy outline of the hand, the difference from the ordinary shadow from obstruction to the solar rays being that the bones are marked as dark shadows, because the light does not penetrate so well through the bone, the flesh being very light.

Now, given such a form of energy which will penetrate the soft parts, it is only the perfection of technique that will determine how much we may do with it. If an energy will penetrate an inch, it will penetrate a mile if there be enough energy. And so the perfection of the Röntgen apparatus has consisted simply in increasing the energy until now we can penetrate most of the cavities of the body.

What is needed is a current of high potential and a proper evacuation in the tube. On account of the dry atmosphere we get in this country a good current of high potential from the old static machine. In Germany I should think they would prefer the Ruhmkorff coil, which is simply an enormous faradic battery.

In the case you have just seen there was, of course, a very difficult problem. It meant that if we were to locate the bullet, we would have to penetrate the entire thoracic cavity. There had been reported at that time (July) by some investigators in Germany similar results through perfected apparatus, but when I first tried it I had very little hope of success. But we finally managed, after taking three negatives, to get a picture. Now, you must not expect too much in the Röntgen photographs; you must remember there is no perspective, no depth. You simply have the distance marked in two directions; there is no third equation. And, besides, they are only shadow-pictures. The farther away a thing is from the plate the more faint will be its outline, and this is the reason it is so difficult to see kidney-stones. Kidney-stones are at least two or three inches away from the plate, and by the time the rays reach the plate they are very much diffused and give quite a washed-out picture. But our ability to overcome this obstacle is only a question of time, more surely so if we are able to refract the X-rays, which up to the present time has not been the case.

In the picture from this case you can see a dark smirch that represents the vertebral column, and on both sides there are dark lines marking the ribs. In the body of the ninth vertebra there is a light spot which is not the picture of the bullet. The picture of the bullet would have been dark like the bone, for lead is quite as impenetrable as bone. So that spot must represent the loss of bone produced by the bullet traversing the body of the vertebra. At that point more rays passed through than through the

rest of the vertebræ, and therefore the picture there is light instead of dark.

This picture, which is much clearer on the negative, as all these are, taken with the position of the wound, the condition of the sensory paralysis, and the history of the case, caused me to feel quite sure that here was the lesion. So, with the consent of the patient and her friends, and with the assistance of Dr. Ransohoff and Dr. Köhler, I removed the vertebral arches of the eighth, ninth, and tenth dorsal vertebræ, and found the bullet embedded in the body of the ninth vertebra, as this light spot indicates. The cord itself, so far as we could see, had not been lacerated, but there were large veins on the pia mater, which indicated it had been subjected to pressure for a considerable time. The bullet and pieces of bone pressing on the cord from the front were removed and the wound was closed. The union was perfect. Recovery from the operation was prompt and complete.

The prognosis I am afraid (although Dr. Ransohoff will say more on that) is not as favorable as it appears. We have endeavored with the water-bath to take away the weight of the patient, and the bed-sores have improved. The rectum has improved so that she has now conscious evacuations. The septicæmia, which was undoubtedly present before, had disappeared; the chills and fever which she had are all gone. Whether we will have regeneration, whether the nerve-fibres will be reformed, is problematic. At any rate, these cases are not to be pronounced fatal too soon. We all of us have seen cases of tuberculosis, for instance, with paraplegia of a year's duration which eventually recovered. I have myself seen cases under Professor Horsley in which he would not give a fatal prognosis under six months.

The surgical aspect of this case will, however, be better discussed by your professor of surgery.

DR. WHITTAKER.—I will now ask my colleague, Professor Ransohoff, who has taken a deep interest in this case and who has favored us with his counsel and assistance, to say to you something of the surgery of injuries to the spinal cord.

DR. RANSOHOFF.—I am sure the gentlemen who have preceded me are to be congratulated, for no case has been more beautifully handled in a scientific and surgical way than this one. There can be no question that the method of examination just outlined is one of the most valuable that can be conceived; yet we must say it is almost the last thing that should be tried. We might almost class it with the exploratory operation, in a surgical way, as a means to be used only after every other resource looking to a correct diagnosis has been tried.

In this case the wound in the ninth dorsal vertebra was very beautifully outlined by the X-ray photograph; yet I am convinced that my colleague and Dr. Kramer came to the conclusion, before the photograph was taken, that the injury in all human probability was in the eighth or ninth dorsal vertebra, neither higher up nor lower down. In many cases we must

reach conclusions without the use of the X-ray, because in many of these cases the X-ray may not be successfully utilized. For instance, in tumors of the spinal cord, the X-ray would not enable us to come to any conclusion as to the site of the tumor, since it would probably be permeable to the X-ray. Yet we know tumors of the spinal cord have been localized accurately without the X-ray. The X-ray, therefore, while of the greatest help in localizing a primary bone lesion secondarily involving the spinal cord, like this, is of uncertain value in diseases of the cord proper. We can come to a very accurate diagnosis without the X-ray. This is fortunate, for in many parts of the country a diagnosis *must* be made without the aid of this highest scientific light.

In the case presented there was a complete paralysis as to muscle, sensation, the rectum, and the bladder. Investigation revealed the fact that from just above the umbilicus downward there was absolute loss of sensation. The respirations were altogether diaphragmatic and intercostal. The abdominal muscles played no *rôle* whatever in the respiratory act. So we came to the conclusion that, certainly so far as the respiratory muscles supplied from the sixth dorsal vertebra were concerned, the lesion must be below the sixth dorsal vertebra. And since sensation was interfered with from the umbilicus downward, we likewise came to the conclusion that the lesion was between the seventh and the ninth dorsal vertebra. Now, in this case we had further help in determining the site of the injury, from the place where the ball entered; the bullet passed through the epigastrium and then through the stomach, giving the history of the vomiting of blood. This is especially interesting, for how the bullet could pass around the abdominal aorta, the vena cava, and the thoracic duct, in its passage from the epigastrium through the stomach to the spinal column in this region, is very difficult to understand. That the paraplegia was instantaneous, we were told by a practitioner who saw the patient at the time. This almost invariably means a fracture of the body of a vertebra,—either one which destroys the cord by cutting it in two, which is very rare, indeed, or one that presses upon the cord and pulpifies it. There are other possibilities for the production of paraplegia. We might have a paralysis coming on gradually in consequence of pressure on the cord, of hemorrhage, or inflammatory exudates. In fractures, as a rule, the damage done is instantaneous, and that is precisely what was found in this case.

At the time of the operation, we found the bullet embedded in the vertebral body without projecting into the vertebral canal. It had raised in front of it fragments of bone, which pressed against the membranes of the cord and pulpified the latter within the membranes. This is what is almost invariably found in injuries of the spinal cord, whether they are the result of gunshot wounds or of trauma received in other ways. Almost invariably fragments are found which have not cleanly divided the cord, but have pulpified it.

We found here the loss of reflexes to which your attention has been

called by Professor Whittaker. Whenever we have complete paraplegia with loss of the deep reflexes, it means, almost invariably, if not a cutting across of the cord, such as would be made in physiological experiment, which is very rare, indeed, at least a pulpification that is almost equal to a complete cutting across. That is the reason why so many surgical operations done upon the cord for the relief of pressure and fracture have failed to give good results. Pott's disease has been alluded to as causing paraplegia. This form of paraplegia very rarely comes on suddenly. Such a paraplegia is almost invariably of gradual development. The cord in such cases is merely pressed upon and not as by a fragment. We have a thickening of the membrane and the fibres of the cord are displaced in their relations to each other, and when the thickened mass of membrane is removed, the spinal cord very soon regains its proper anatomical relations, and therefore its normal physiological functions. The paraplegia of Pott's disease is often recovered from without surgical interference of any kind.

And yet in every case of fracture of the spine with such complete paraplegia there is only one hope for the patient, and that is operative relief. But I have never seen a case of fracture here recover: the higher the fracture, the more speedily fatal will be the termination.

The patient may possibly live for months or for one or two years when the cord has been injured to this extent, but eventually these patients die. When only the fibres of the cauda equina are injured, the prognosis, of course, is very much better. But the clinical phenomena presented by this patient, the bed-sores, pain, convulsive movements, morphine habit, make it certain that the patient would have died had nothing been done,—and there was only one thing to do, and that was to operate. This is not a new procedure: it has been adopted time and again in the hope of finding only pressure, without disintegration of the cord. Before the advent of antiseptic surgery the mortality was frightful, seventy or eighty per cent. of the patients dying, within a week at most after operation, from septic infection. Since the days of aseptic surgery the operation has been followed by very much greater success, so far as danger to life is concerned. The mortality has been reduced to about thirty-eight per cent., which is entirely due to the fact that infective diseases have been largely excluded, hence the patients do not die in a week or ten days from upward extension of inflammation of the membranes. Still thirty-eight per cent. of the cases do die soon after operation, even under our modern methods of operating, and they die as they would die if the operation were not performed.

Not long ago I saw a patient in Illinois, upon whom a tree had fallen. Within forty-eight hours the patient had very deep bed-sores. He was nearly exhausted from using his diaphragm alone in breathing. The conditions were not such as to warrant operation, for this is not an operation to be undertaken in every case. The patient died within forty-eight hours after I saw him. I did not operate upon him; he would have died any way, and the death might have been ascribed to the operation.

But the only chance for the patient presented to you here to-day was in operation,—not a very brilliant one, it is true; it was, however, the only chance the patient had, and she certainly was entitled to it. The opening up of the spinal column is a very difficult procedure. You have seen it in the dead-room. Very few pathologists are fond of opening up the spinal canal. The operation is made difficult because of the depth at which the laminae of the spine are placed and on account of the extreme hardness of the bone. The incision must be made much longer than is necessary for ordinary operative procedures. The muscles must be severed from the spine and held aside by retractors. Then with heavy forceps the spinous processes are removed. After that is completed, with bone-cutting forceps or saw (one usually uses one instrument after another) the laminae are cut through first on one side and then on another, removing completely the arch of the vertebra. This sounds easy, and would be easy if it were not for the fact that we have veins in the spinal canal that are very thin-walled and difficult to see, and that bleed very freely. We have one, for instance, on either side of the middle line. After the pressure is removed from within the spinal canal, these veins have a distinct tendency to bleed. But with hot water, pressure, and a ligature here and there, it is possible to control this hemorrhage and expose the membranes. Then it is easy to introduce a third retractor and bring the cord over to one side and find the bullet. First, however, in this case, we could feel through the cord the hardness produced by the bony fragments which the bullet had displaced.

This patient has done admirably. Yet I am afraid, with Dr. Kramer, that the case will not progress as it would were all things in this world as they should be. The question is whether the bed-sores are better from changes in the cord or from the water-bath. I am inclined to think the latter is the case. When changes take place in the cord for the better, they usually come on with considerable rapidity. Had the damage in this case been only from compression, we should have had better results than have thus far been achieved. The rectum is better, the bladder remains unchanged, the reflexes have not returned. We must, therefore, come to the belief that, although some little improvement seems to have taken place, further advance must be more a hope than an expectation. In every case of fracture of the spine, having first clearly put before the patient the chances of recovery with operation and without, if you can gain the consent of the patient, by all means operate. Without operation the prospect of recovery is remote; with it some hope is offered. But let us trust, not only for the sake of the patient but for the light of the profession, that the results in this case will not be as dubious as we now believe.

DR. WHITTAKER.—Let us, now that the patient is transferred to her room, study the case as physicians from the stand-point of the chief symptoms which are shown,—to wit, the loss of motion, of sensation, the abolition of the reflexes, the pain, the spasmodic contractions, the interference with the action of the bladder and bowels, and the vasomotor and trophic

disturbances. And in this study let me say something of the new doctrines concerning the physiology of the cord.

We know, from the studies of Bell, that the anterior cornua have to do with motion and the posterior with sensation. This much is positive knowledge. Experiments upon the lower animals teach us also that the motor and sensory fibres run a separate course for a time; the motor through the anterior, and the sensory through the posterior parts of the cord, so that the anterior gray substance has to do chiefly with motion and the posterior gray substance chiefly with sensation. Here come in now, however, other fibres, centrifugal and centripetal, which, almost unintelligibly, certainly contradictorily, complicate our knowledge of the functions of the cord.

It was ascertained from the experiments of Schiff that division of the whole cord, with the exception of the posterior columns, abolishes the sense of pain,—that is, produces the condition which is distinguished as analgesia. But if the smallest portion of the posterior gray substance is left, it will suffice to conduct sensation of pain, though the conduction will be somewhat retarded. That peculiar disease of the spinal cord marked by the formation of cavities, and hence known as syringomyelia, is distinguished by paræsthesia, but especially by diminution or loss of sensation to pain and heat, so that burns are not felt, or are discovered only by the destruction of tissue. But the sensation of touch and the muscular sensation are usually unaffected. Trophic changes are, however, very common. The surface becomes cold and cyanotic, and the patient succumbs to bed-sores, cystitis, and marasmus. This is a good deal like the picture which is shown in our case, and the condition would indicate most serious damage to the gray matter of the cord.

May we determine if only one half of the cord is hurt?

Brown-Séquard long ago observed that section of the lateral half of the cord in the cervical region was attended on the same side by paralysis of voluntary motion and of the muscle-sense, as well as of the vasomotors, as indicated by the higher temperature of the skin; also by an increased sensitiveness to touch and temperature of the trunk and extremities,—that is, by hyperæsthesia; and on the opposite side by anæsthesia of both the extremities, and by the abolition of all varieties of sensation except the muscle-sense, while motion was preserved intact. We have here no hyperæsthesia and no conservation of muscle-sense.

Conduction of the muscle-sense would seem to take place in the posterior columns, as disease of these columns—*e.g.*, locomotor ataxia—or any interruption of continuity leads to disturbance of co-ordination.

The lax and flabby condition of all the muscles below the line of lesion shows the loss of muscle-tone in our case. This muscle-tone has heretofore been regarded as a kind of excitation arising automatically in the spinal cord and keeping the muscles in a state of partial contraction. This view, however, has been entirely abandoned in our day as untenable. No such

force ever develops spontaneously in the cord. All nerve force is now known to be the result of extraneous impression, so that the muscle-tension is better explained as a reflex tone conveyed through the motor nerves in response to stimulus from the sensitive nerves. The stimulus for this action is found in the continuous impression of outside influences, touch, temperature, sustentation of weight, as of parts of the body, circulation, etc. These impressions received upon the surface of the body or through sensitive regions act in a reflex way in securing that light tension of muscle which is known as muscle-tone, and the muscle-tone itself is a direct expression of the influence of the sensitive upon the motor nerves, or we might say of the posterior upon the anterior roots.

For the same reasons we are led to believe that the sensation of touch is probably also located in the posterior columns, while that of temperature, as stated, is chiefly conducted through the gray matter. Herzen went so far as to claim as a result of his experiments and clinical observations that the sensation of cold was conducted through the posterior columns and that of heat through the gray matter, but these conclusions have not yet been verified. The vasomotor nerves run in the anterior columns, which they leave to penetrate the gray matter, and thence issue through the anterior roots and the communicating branches to enter the sympathetic nerve. These nerves are certainly centrifugal, as the blood-vessels are paralyzed below the line of section, while stimulation of the distal portion leads to contraction of the vessels. Stricker claims that vaso-dilators run in the posterior cornua. The course of the secretory and trophic nerves, if such exist separately, is entirely unknown.

You have heard so much of reflex action as, perhaps, to have been led to believe that the course of a sensitive nerve has been directly traced to a ganglion in connection with the motor nerve. But while such a communication has been assumed, it has never been actually demonstrated. The simplest reflexes complete their arch in the same section of the cord, and Gad has shown that contralateral contraction, what is known as the crossed reflex, may occur in the same short segment of cord-tissue. The simplest reflexes are seen in the so-called patellar and plantar reflexes. The most interesting of these are the crossed reflexes, in which a stroke, for instance upon one knee, brings out a more marked contraction in the opposite leg, while it may show little or no response in the knee which receives the blow. This condition is seen in hemiplegia and after injury of the cord, and is dependent upon the different excitability of the reflex centres of the two sides.

The total abolition of the reflexes upon both sides in our case is a fact of very serious import. Bastian reported four cases of total destruction to the upper dorsal portion of the cord in which the reflexes were entirely lost. Bruns reported also such a case in which the subsequent post-mortem showed the integrity of the lumbar region of the cord. Now, as the lesion of the cord in these cases is above the centre of the patellar reflex, which

lies in the upper portion of the lumbar enlargement, the abolition of reflex action can be explained only by inhibition. The reflexes are inhibited in various ways, but especially by interruption of the course of the fibres from the brain. Setschenow removed the cerebral hemispheres in a frog, irritated the optic lobes by crystals of common salt, and thereafter found marked retardation of the reflex action. But extreme irritation of any part of the nervous system may have the same effect. Sherrington found that irritation of the sciatic nerve inhibited the patellar reflex.

The doctrine so long undisputed, that section of the cord above a reflex arch increased reflexes of the lower part of the body, has been combated recently by Bastian, Bowlby, and Bruns, who showed that entire cross section destroyed the reflex below it, and that the former view depended upon the fact that the cross section was imperfect, for it is claimed that reflex activity of the cord persists only when a certain amount of excitation passes from the cerebellum to the cells of the anterior cornua. This view, however, is not entirely unassailable, for it is observed in cases of decapitation that the reflexes persist for perhaps a minute after execution.

May we learn anything of the extent of the damage in our case by the electrical reactions?

A few muscles in the legs, notably the adductors, show in our case only the feeblest reaction to the faradic current. It is difficult to determine the reaction of degeneration. If there is any response to the galvanic current it is exceedingly feeble. The galvanic current should excite prompt response, but the action here is so feeble as to be hardly recognized.

In order to show a perfect reaction of degeneration the muscles should respond not to the faradic but to the galvanic current, at first excessively and later less and less, until, finally, there is no response at all. In the partial reaction the muscle is feebly excitable by the faradic current. There are no fibrillary twitchings, but there are occasional spontaneous contractions which move the legs.

The study of the condition of the nerves and the action of the muscles is rendered additionally difficult in our case by the fact that the patient suffers so much pain as to necessitate the use of morphine. Just how much pain the patient experiences is difficult to say. There is no sensation whatever in the lower half of the body, and no pain is felt in this region, but severe pain is complained of in the upper half, especially in the shoulders, and it was to relieve this pain that the patient has been obliged to use morphine in constantly increasing doses, so that now the opium habit is superadded to the symptomatology.

There is a form of paraplegia known as *paraplegia dolorosa*, which is marked by extreme pain in the back and in the paralyzed members. This condition is usually due to progressive compression, and is seen most frequently in cancer of the spinal column.

The evils of damage to the cord do not always show themselves at once. Gowers divides his cases of this type into three classes: 1, those in

which the injury causes immediate and severe paralysis due to instant damage to the spinal cord ; 2, those in which there are at first either no symptoms or only trifling disturbance, but in which grave symptoms set in after a few days or weeks ; 3, those in which there are no early symptoms, but symptoms set in in the course of one or several months. In one remarkable case reported by Grawitz, the signs of compression of the cord did not develop until two years after the initial lesion. During the next two years the symptoms improved ; at the end of that time the patient succumbed to miliary tuberculosis. The cord showed secondary degeneration, with fresh softening at the point of compression, probably in consequence of the tuberculous arachnitis.

The difficulty with the bladder and bowels in our case has largely subsided, notwithstanding the persistence of the paraplegia, so that the bladder now empties itself and the bowels are sometimes evacuated spontaneously ; indeed, of late there has been an occasional tendency to diarrhœa. It is needless to state that this voluntary movement of the bladder and bowels, like the spontaneous movements of the legs, is due to reflex action, which asserts itself in its own centres in the cord below the seat of the lesion.

It is astonishing what pressure the cord may endure under gradual tolerance. Grawitz reported the case of a soldier who continued on duty up to eight days before death, notwithstanding an extensive softening from caries of the vertebra. This disease sheds some light upon our case, because caries of the vertebra, while it may occur at any portion of the spinal column, shows itself most frequently in the lower dorsal vertebræ.

The degree of accommodation or compensation which may be accomplished at times is almost incredible. Thus Joachimsthal reported in Virchow's *Archives* last year the case of a man, aged twenty-nine, who suffered from complete paraplegia, but who—it seems almost incredible to relate—"was able to stand, to walk, to climb, and even to jump, and in such a perfect manner as to be able to appear before the public as an artist." Long practice had developed to real Herculean proportions the muscles of his body, shoulders, and arms,—else was he able only to move with two crutches. Both the bones of the forearm were enormously enlarged. Something like this is seen in congenital defect of the tibia, where the fibula in assuming the rôle of the absent bone becomes extraordinarily thickened.

The most desperate cases may not be despaired of. In one case, also reported by Grawitz, the symptoms of compression from tuberculous spondylitis in connection with gangrenous decubitus and thrombus of the right and left femoral vein, all gradually disappeared.

Considering all the facts now in our case, with full appreciation of the immediate danger of death by decubitus, that is by sepsis, by cystitis, marasmus, inanition, and with definite knowledge of the extent of the damage done to the cord, what may be the hope of improvement from possible regeneration of the nerve-tissue ?

The possibility of regeneration of nerve-tissue in the cord seems to be decided rather in the negative. Ströbe found that after injury to the cord, cicatricial tissue developed from the granulation-tissue at the borders of the wound in forty-five days. Young, newly-formed fibres originated from the posterior roots and projected themselves into the cicatrix. These fibres had the characteristics of young fibres,—that is, they showed light varicose swellings, undulatory serpentine course, with the formation of a net-work whose elements were spun round each other in irregular spirals. The young fibres were provided with a distinct sheath. Besides, fine fibres were developed from the white substance of the cord in individual regions; these fibres penetrated the zone of degeneration and could be followed into the cicatrix, where they were lost. These fibres also showed the characteristics of young nerve-fibres, as they took their course between the cells of the cicatricial tissue. It seemed as though they originated from the old fibres which had been divided. But it was clear that the formation of these fibres was limited to a very narrow region. It seemed as though there was an attempt at regeneration, but there was no real new formation, nor real regeneration of nerve-tissue. The nuclei of the connective tissue were somewhat increased from the second week on, but proliferation of the glia was still very slight even as late as forty-five days. Typical mitosis was very rarely seen; this is in correspondence with the slow increase of tissue. Moreover, typical granular cells were extremely rare in the field of secondary degeneration. So it seemed to be decided that the glia was not able to fill out any great defects such as result from sections or centres of softening. These defects are either repaired by a cicatricial tissue or, in case of great loss of substance, by a membrane of connective tissue at the border surrounding a permanent cavity.

The observations which would seem to indicate the possibility of regeneration were made in the lowest animals, and even here the results obtained are not accepted without dispute. For instance, in the case of the lizard there is restored after the amputation of the tail not only a new tail, but also that part of the spinal cord which had been lost; but it has not been demonstrated that the restoration of the cord is attended with real restoration of function (Müller). Sgobbo claimed that a section of the dorsal cord of the triton was followed by evidence of degeneration originating in the epithelium of the central canal. Leyden and Goldscheider quote from Massius and Vanlair the observation that the interspace caused by the removal of a piece of the spinal cord of a frog, one to two millimetres in length, was filled in the course of a few months with a yellow gelatinous mass in which could be traced cells and fibres, which the authors believed themselves justified in regarding as ganglion-cells and Remak fibres. They observed also an apparent restoration of function in a certain degree, but anything like an exact conclusion could not be drawn, from the fact that the lower part of the cord is the centre of so many reflex motions, many of which simulate voluntary motions. Goltz and Frensborg showed how varied, com-

plicated, and apparently voluntary are these reflex motions in the dog. Voit, as well as Deval and Laborde, observed in the skull of a pigeon after removal of the brain a remarkable new formation of matter much like nerve substance. Brown-Séquard observed restoration of voluntary motion in certain degree after entire cross section of the cord. In these cases the divided ends of the cord had united, and ganglion-cells and nerve-fibres were found in the scar. But Sgobbo was not able to confirm these results; the functional restoration was only apparent, and this was caused by reflex action. A number of the best observers have seen restoration of function in the dog after half section of the cord without the development of new fibres in the cicatrix, the function, of course, being performed, therefore, by fibres in the other half of the cord. But equally good observers still maintain that cross section of the cord in the dog and other animals was followed neither by functional restoration nor by the formation of new nervous elements in the cicatrix. Marinesco, in his experiments upon the brain, saw karyokinesis in certain ganglion-cells, but never anything like a real proliferation. The cases, therefore, of improvement and apparent restoration of function after hemorrhage, compression, and other damage are probably to be referred to disappearance of œdema, relief of pressure, absorption of effused blood, compensation by other nerve-fibres, etc., and are not due to regeneration. We must conclude, therefore, with Leyden and Goldscheider that experiments only lend support to the melancholy fact that we know as yet no sure signs which would indicate the possibility of a regeneration of the spinal cord.

REVIEW OF MEDICINE.

MEDICINE.

IN CHARGE OF JOHN H. MUSSER, M.D.,

Assistant Professor of Clinical Medicine in the University of Pennsylvania; Visiting Physician to the Presbyterian and Philadelphia Hospitals,

J. A. SCOTT, A.M., M.D.,

AND

JOSEPH SAILER, M.D.,

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the Pennsylvania Hospital,

Associate in the Pepper Clinical Laboratory.

A Case of Thrombosis of the Abdominal Aorta. (*British Medical Journal*, October 24, 1896.) By Walter Bell, M.D.

The patient's wife had been treated for syphilis, but he himself, an apparently healthy man of thirty years, gave no history of any previous disease. The condition commenced suddenly with intense pain in the back and abdomen, the legs became powerless, and the patient fell to the ground, but did

not lose consciousness. He was admitted to the hospital in a state of severe shock, the lower extremities were absolutely paralyzed, and there was anæsthesia and analgesia extending upward as far as the lower third of the thigh, above which point there was a zone of hyperæsthesia two inches broad. Over the rest of the body cutaneous sensibility appeared to be normal. The reflexes of the lower part of the body were abolished. There was severe pain in the lumbar region and in the thighs and legs. The patient rapidly became worse, control over the bladder and sphincter ani was lost, and the lower extremities were deadlly cold and quite pulseless. The kidneys apparently soon ceased to functionate, for only small quantities of very fetid urine could be obtained by the catheter. There was severe delirium and subnormal temperature. Gangrene commenced in the right calf and the scrotum, and the breath had a gangrenous odor. Death occurred fifty-six hours from the onset. A partial autopsy only was allowed. The lumbar enlargement of the cord appeared to be normal and was so reported, after microscopical examination by the Clinical Research Association. In the aorta a firm white fibrous thrombus was found, totally occluding its lumen, and extending from the inferior mesenteric artery to the bifurcation, a distance of about one and three-quarters inches, and for about an inch into either common iliac. [It is impossible to believe, in view of the results of experimental ligation of the aorta by Nissl and others, that an adequate examination was made of the portion of cord excised: some of the symptoms seem to indicate degeneration of the ganglion-cells. Unfortunately the obstinacy and ignorance of the relatives prevented a more thorough study of the various changes.]

Concerning the Amount of Nitrogen or Albumin contained in the Sputum in Various Diseases of the Lungs and the resulting Loss of Nitrogen to the Organism. (*Deutsche Archiv für klinische Medicin*, March, 1896.) By Dr. Friedrich Lanz.

The author endeavors to answer the following questions: Is the amount of nitrogen in the sputum different in different diseases of the lungs? Does it vary in different stages of the same disease? Is it sufficient to affect and change the tissue metabolism? The method employed was to make two nitrogen estimations according to the method of Kjeldahl, the ratio of nitrogen to albumin being taken as 1 to 6.25. In sixteen cases of pulmonary tuberculosis the minimum percentage of nitrogen was found to be 0.2698 per cent., and the maximum 1.1459 per cent., the mean of thirty-six estimations being 0.6795 per cent., corresponding, when reckoned in connection with the daily amount of sputum, to an average daily loss of 4.1306 grammes of albumin, a quantity not to be neglected when it is considered that it occurs daily for long periods.

Three cases of pyopneumothorax showed considerable variation according to the nature of the condition. Two of these were tubercular in nature, and in both the amount of albumin lost was considerable, exceeding 13.5

grammes per day. In the third, non-tubercular, it was only 4.25 grammes per day. In four cases of pulmonary gangrene following pneumonia considerable difference was found according as the amount of sputum was profuse or not; but Lanz is inclined to believe that the percentage of nitrogen in the sputum is in reality small, the larger proportion of proteid matter being due to fragments of tissue. In pneumonia, on the other hand, the amount of nitrogen was excessive, reaching at times more than 1.5 per cent., and corresponding to a loss of five or six grammes of albumin per day; a quantity not of itself serious in an acute disease, but important to take into consideration in analyses of tissue change. In a number of cases of bronchitis the amount of nitrogen was found to be very variable, bearing, however, some relation to the severity and extent of the process, and in long-continued cases unquestionably causing injury to the patient.

A Case of Subphrenic Pneumothorax. (*British Medical Journal*, October 24, 1896.) By F. Nicholson, M.D.

The patient, formerly a soldier in the Indian service with a history of dysentery, had suffered for about a year with a dull aching pain in the lower part of the right chest. The percussion note over the right chest anteriorly was high pitched and tympanitic, but good vesicular breathing was heard everywhere. The area of hepatic dulness was greatly diminished in its upper part, and measured only an inch in the mammary line, and there was marked tenderness in the region of the gall-bladder. In all other respects the physical examination was negative. Later it was found that the bell sound was limited to the right chest anteriorly, and that a succussion splash could be heard anteriorly and posteriorly below the nipple line. When the patient was made to sit up, the area of hepatic dulness increased to three inches in the nipple line. A diagnosis of subdiaphragmatic abscess containing gas was made, and subsequently confirmed by an operation.

THERAPEUTICS.

IN CHARGE OF ALEXANDER D. BLACKADER, B.A., M.D.,

Professor of Therapeutics, McGill University, Montreal, Canada,

ASSISTED BY

D. J. EVANS, M.D.

A Discussion on the Treatment of Cardiac Failure. (*British Medical Journal*, September 19, 1896.)

Sir T. Grainger Stewart, M.D., F.R.C.P.E., opened the discussion on this subject at the Sixty-fourth Annual Meeting of the British Medical Association. Among all the agents at our disposal the most important is rest. It is rest from laboring work that tells most favorably; and, although rest is good for all heart cases, it is much more effective in these cases than

in any others; for by the time a man who leads a comparatively easy life begins to exhibit the general symptoms of cardiac failure his cardiac muscle is, as a rule, so much deteriorated as to be less capable of a rally than that of the laboring man exhibiting corresponding symptoms. Second in importance is the element of hope. Next to rest and hope diet should be placed. Some cardiac patients benefit by an increased allowance of nourishment; some by a diminution of the amount; and many by an alteration of its quality. Along with diet it is necessary to consider the use of alcohol as a substance for habitual consumption.

1. Any excess, even habitual slight excess, is to be strongly deprecated in all cases of threatening cardiac debility.

2. Its use in any form which is unsuitable to the stomach, giving rise to dyspepsia and secondarily disturbing the heart's action, must, of course, be forbidden.

3. Its employment in moderate doses is of great service in cases of cardiac debility, and especially in such debility as we have seen of late years following influenza or diphtheria or any other acute exhausting disease, as well as in the advancing cardiac weakness so common in later life. The best form of alcohol is, in the majority of cases, whiskey, and the dose may vary from two drachms to two ounces. The amount for habitual use should never exceed four ounces in twenty-four hours. It should always be taken with food, and, if apart from the ordinary meals, should be mixed with milk or milk beaten up with white of egg.

Passive exercises resulted :

1. In the great majority of cases of cardiac dilatation, in diminishing the area of cardiac dulness perceptibly during each administration of massage.

2. In improving the character of the cardiac sounds and the rhythm and strength of the pulse.

3. In causing the patient to experience a sensation of comfort and to feel better for the treatment.

4. In one or two cases, in producing the opposite effects in all these particulars, apparently because the heart was feeble and because the patient was fatigued at the time of application.

5. In producing permanent results, although the immediate favorable effects passed off in a few hours.

6. In bringing about a permanent diminution in the area of dulness with improvement of pulse and of the patient's sensations after repeated massage.

7. In a case in which the Schott treatment was unsuitable in giving the most striking benefit.

The physiological explanation of these phenomena is as follows :

1. During the massage of muscles the flow of blood through them is increased.

2. Immediately after the cessation of massage an accumulation of blood occurs in the massaged muscles; this is rapidly followed by an increased flow through the muscles.

3. The massage of a considerable muscular area causes at first a slight rise in the general blood-pressure; this is followed by a fall which in some cases amounts to one-fifth of the initial blood-pressure.

The Schott method of treatment by resisted movements produces :

1. In a large proportion of cases an immediate improvement in the condition of the heart as shown by percussion and auscultation, the sounds becoming more distinct, and the area of dulness diminishing to a greater or less extent.

2. An improvement in the rhythm of the pulse and a more vigorous heart action in many cases.

3. A gradual improvement of a lasting kind, so that the heart recovers its tone and the area of dulness diminishes.

The system of resisted movements is best suited to cases in which a certain power of heart exists, while the mere passive exercises of massage would be applicable to still weaker conditions of the organ.

The method of Oertel, by climbing heights, is followed by excellent results. This method acts primarily by increasing the volume of blood in the muscles and in the skin, thereby relieving the overloaded heart. In this form of exercise a greater muscular power of the organ is demanded than in either of the other systems.

The Nauheim baths of saline and gaseous solutions produce, while the patient is in the bath, an unmistakable reddening of the skin from dilatation of the vessels; and concurrently a pulse of more regular rhythm and strength and slower in rate. The cardiac dulness is also diminished. It is probable that the effects are due to mechanical dilatation of the vessels diminishing peripheral resistance, thereby rendering the work of the overtaxed heart easier. Neither the individual forms of the exercises nor the baths, nor even the combination of the two, is entitled to displace our former treatment by means of rest, diet, and medicine; but each of the exercises and the baths, and still more, their combination, constitute a very valuable addition to the older methods of treatment.

Of the cardiac tonics digitalis is the most valuable. Whenever diarrhoea and vomiting occur we may conclude that we are giving more than is needed for action upon the heart. Digitalis possesses a greater power of contracting the arterioles than any other medicine of the group to which it belongs.

Strophanthus stands next to digitalis. It acts powerfully and rapidly upon the cardiac muscle; but has little influence upon the muscular fibres of the arterioles. Theoretically, therefore, strophanthus should give better results than digitalis. This is not so clinically. Strophanthus is better to use in an emergency, as it acts quicker. The results of strophanthus correspond essentially to those produced by digitalis; and often where digitalis has failed to suit the stomach strophanthus has been fallen back upon with good result. In a certain proportion of cases strophanthus disturbs the stomach more than digitalis does, and has to be discontinued for this cause.

Caffeine, nux vomica, and strychnine are useful cardiac tonics; the latter especially when the other remedies are not well borne.

Among the cardiac remedies which act by dilating the arterioles the best are sodium nitrite and nitro-glycerin. Their effects are purely mechanical.

Iodide of potassium appears to aid the action of cardiac tonics, especially when chronic inflammatory changes are still going on in the valves.

Among the results of cardiac failure to be treated are: dropsy, constipation, catarrh of the stomach, deficient absorption from the intestine, passive congestion of the liver, anæmia, œdema of the lungs, and albuminuria.

R. F. C. Leith, M.A., M.B., F.R.C.P. (Edin.), said that he was inclined to doubt whether the sudden benefits obtained by the Nauheim method were not, after all, to be explained largely, if not entirely, by the influence of the mental factor.

J. Liddell, M.D., and W. Edgecombe, M.B., found the movements and aerated baths of great benefit in the treatment of cases of cardiac failure.

Byrom Bramwell, M.D., divided all the remedies useful in the treatment of cases of cardiac failure into: first, those which increase the tone of the heart muscle; and, second, those which diminish the work of the heart and peripheral resistance. He thought rest and cardiac tonics were the most useful remedies which we possess.

Alexander Morison, M.D., considered the balneological and gymnastic treatment of heart-disease a permanent addition to our means of treating cardiac failure.

Harry Campbell, M.D.—Baths and resisted movements lead to a diminution of blood in the systemic veins and lungs and to a corresponding increase in the systemic arteries. They do this by (a) producing a widespread tonic contraction of the muscles; and (b) increasing the mean capacity of the lungs.

W. G. Earle, M.R.C.S., L.R.C.P.—The effects of the Nauheim baths are, in my opinion, due to the withdrawal of heat from the system. This is considerable, owing, probably, to the iron salts present, although it is not apparent on account of the tingling sensation the waters produce.

T. D. Savill, M.D.—The benefit of the baths and exercises was evidenced, first, by promoting the peripheral circulation, and thus relieving the overburdened heart; second, by promoting the circulation through the tissues and organs, increasing their nutrition.

Theodore Fisher, M.D. (Lond.), thought that dilatation of the heart unassociated with valvular disease would be most benefited by the Nauheim treatment.

NEUROLOGY.

IN CHARGE OF LANDON CARTER GRAY, M.D.,
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GUY HINSDALE, M.D.,
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WILLIAM BROADDUS PRITCHARD, M.D., AND
New York City,

WM. G. SPILLER, M.D.,
Philadelphia.

A Case of Rapidly Fatal Cerebritis, resembling Cerebro-Spinal Meningitis, with Exhibition of Sections of the Cerebrum, Mid-Brain, Pons, and Post-Oblongata. (*Journal of Nervous and Mental Disease*, September, 1896.) By James Hendrie Lloyd, M.D., and Joseph Sailer, M.D.

In the first part of this interesting paper a few remarks are devoted to the manifold nature of the disease known as cerebro-spinal meningitis. The following case is reported: A young man, of about twenty-six years, was seized with a sudden severe chill, followed by high fever, headache, and pains in the back and limbs. There was no history of vomiting or convulsions. Delirium developed within twenty-four hours. No history of exposure to infection could be obtained. He was treated at his home for typhoid fever. On the third day of the process it was observed that the patient's left upper eyelid drooped, and that the left eye was turned outwards. A spot of ecchymosis appeared below the lower lid. On the fourth day he was admitted to the hospital in a pronounced typhoid state, and with total paralysis of the left third nerve, which naturally rendered the typhoid nature of the process doubtful. Some tonic spasm of the muscles of the jaw and a rose-colored eruption over the malar bone were noted. The surface of the trunk was hyperæsthetic, otherwise there were no symptoms of irritation of nerve-centres or of the meninges. In a very short time a papular eruption appeared on the face and forehead, and rapidly spread over the entire body. Within a few hours hemorrhage into the tissues occurred, in some places as large as a silver half-dollar. Blood was vomited, and blood, pus, and casts were found in the urine. The disease was diagnosed as cerebro-spinal meningitis.

At the autopsy, hemorrhagic and purulent foci in the cerebrum and punctate hemorrhages in the mid-brain were observed. At the microscopic investigation the pia of the cord appeared slightly thickened, its vessels were dilated and engorged, and contained many leucocytes. About some of the vessels was a slight, round-cell infiltration. Within the cord the larger vessels were not affected, with the exception of an occasional perivascular infiltration. The distinctive alteration consisted of disseminated foci of round-cell infiltration within the gray and white matter. These foci were composed of simple polynuclear cells, with deeply-stained nuclei; such cells were also found scattered singly through the tissues. An obliterated capillary was found at the centre of some of the cellular accumulations. The cell-body of certain of the ganglion cells was diffusely stained, the contour

was irregular, and the processes were absent. The chromophilic bodies in the cells of the hypoglossal nuclei were more irregular in outline, and occasionally a little mass of deeply-stained matter was found to one side of the nucleus. Nerve-cells situated within a focus of round-cell infiltration were much altered. A large focus was found in the left crus, and the cells of the substantia nigra were greatly degenerated. The examination for micro-organisms was negative. From the microscopical findings the process should be considered as acute interstitial encephalitis.

The Functions of the Neuron. (*Journal of Nervous and Mental Disease*, August, 1896.) By F. X. Dercum, M.D.

Dr. Dercum is not willing to deprive the nerve-cell of the honor of transmitting impulses, as Nansen has done; he is not willing to believe that the cell-body is side-tracked, and that the propagation of the excitation is through the cellular processes alone.

The theory of amœboid movement as applied to nerve-cells has been advocated by Rabl-Rückhard, Lépine, Mathias Duval, and opposed by Kölliker and Ramón y Cajal. Dr. Dercum contends that Cajal practically admits what he verbally denies. If his theory is true that the processes of the neuroglia cells possess this mobility, that they penetrate between the arborizations of the nerve-cells and in this way prevent their contact, then a passive movement does take place. The question is not in regard to degree but to the existence of any mobility at all in cellular processes. A single positive observation outweighs, as Dr. Dercum says, all negative ones. Wiedersheim saw the nerve-cells in the œsophageal ganglion of a living animal (an entomostracan) move, and while from this statement the claim is not made that nerve-cells in vertebrates possess a gross amœboid movement similar to that in the cells of this low type, the observation justifies the assumption of a certain amount of mobility in the human nerve-cells.

Dr. Dercum employs this idea in explaining hysteria. Hysterical paralysis is due to imperfect contact of the cortical neurons with the spinal. Sudden restoration of power means the re-establishment of normal relations. In the same way the shifting anæsthesia and the effects of hypnotic suggestion are explained. Sleep is not the result of anæmia of the brain, but of retraction of the cellular processes. Spontaneous waking means restoration of the exhausted nerve-cell and extension of its processes. Thought is the result of afferent impulses in connection with different combinations of the various neurons.

[Azoulay and Pupin, in France, have recently published their views on the relation of the nerve-cells to one another, and Pupin especially has devoted his attention to the amœboid movement. His view in regard to the mechanism of sleep is like that advanced in the above paper. Dr. Dercum's opinion has been formed independently of the work of these authors, and he may be considered as the first exponent of this theory in America.]

Hysterical Achillodynia. (*Revue Neurologique*, June 15, 1896.) By C. Féré, M.D.

Dr. Féré speaks of the pain in the tendon of Achilles during extension or under pressure on the side of the body in which the hysterical stigmata predominate. It is associated with swelling of the part, and persists after the other hysterical symptoms have disappeared.

Albert has described such a pain in the tendon of Achilles, which disappears when the patient is lying down.

In the two cases reported by Féré the pain appeared to be due to hysteria. Both these patients had hysteria of a severe type. This neurotic pain is not as uncommon as is supposed.

Hemiatrophy of the Tongue, with the Report of a Case. (*Journal of Nervous and Mental Disease*, July, 1896.) By C. W. Burr, M.D.

A young woman, who had had syphilis, came to the hospital complaining of a "crooked tongue." She had had headache, usually behind the left ear, and at times severe vertigo. According to her statement, she awoke one morning and found the left side of the tongue swollen and black, though without pain. Some weeks later this half of the tongue was noticed to be about half as large as the right, was irregularly depressed and elevated, and on protrusion deviated to the left. There were no fibrillary twitchings. Common sensation and sense of taste were preserved. Numbness in the hands was mentioned. During the progress of the affection difficulty in swallowing solids, incoherent speech, pain on the right side of the head, temporary diplopia, slight ptosis, absence of reaction to light, and slight reaction to accommodation were noted.

The author believes the case to be one of basal syphilitic meningitis.

A very careful review of the literature is given.

Pure Word Deafness. (*Revue Neurologique*, No. 12, 1896.) By Hélot, Houdeville, and Halipré.

The patient, whose history is given in detail, suffered for a long time from middle-ear disease, and observed that alcoholic excesses caused a permanent impairment of his understanding of spoken words. After drinking one day more than usual he fell into a state of coma; on regaining consciousness he was unable to understand what was said to him.

All other parts of speech were intact. He could speak, write, read, reply to written questions, write spontaneously, and copy. He said repeatedly, "I know that you are speaking, but I do not understand; I can count the syllables, but I do not grasp the meaning."

He understood, however, a few words and could write them on dictation. Musical deafness was almost complete.

As the word-concept was intact it was necessary to believe that the cortical centre for word hearing was uninjured, and that the lesion was sub-cortical. Ordinary hearing was not affected.

OBSTETRICS AND GYNÆCOLOGY.

IN CHARGE OF RICHARD C. NORRIS, M.D.,

Lecturer on Clinical and Operative Obstetrics in the University of Pennsylvania; Obstetrician-in-Charge, Preston Retreat; Visiting Obstetrician, Philadelphia Hospital; Gynecologist, Methodist Episcopal Hospital; Consulting Obstetrician and Attending Gynecologist, South-eastern Dispensary and Hospital for Women and Children,

AND

LAWRENCE S. SMITH, A.B., M.D.,

Instructor in Clinical Gynecology in the University of Pennsylvania.

A Peripheral Facial Paralysis in an Infant after a Normal Labor. (*Centralblatt für Gynäkologie*, 1896, No. 24.) By Geyl, M.D.

The rarity of such a condition following normal labor makes it interesting. On the morning after birth a loss of function was noticed in the right facial nerve, allowing a drooping of the mouth, an obliteration of the mento-labial and naso-labial folds, and an interference with the action of the lower lid. At the end of two weeks the infant gradually recovered the use of its muscles.

Facial Paralysis in an Infant after a Normal Labor. (*Centralblatt für Gynäkologie*, No. 27.) By Ludwig Knapp, M.D.

In this case the paralysis began to disappear soon after birth, and had vanished almost entirely by the fourth day. This rapid disappearance would exclude a central origin, and Knapp believes the injury to have been caused by the marked pressure œdema of the skin over the branches of the nerve.

A Case of Primary Prolapsus Uteri; Ventrofixation; Twin Pregnancy with a Successful Termination. (*Centralblatt für Gynäkologie*, 1896, No. 24.) By A. O. Lindfors, M.D.

The patient, aged thirty, married one and a half years without pregnancy, had suffered for fifteen years from a prolapse, brought on by harvesting. A colpo-perineorrhaphy six years ago had been a failure, so a ventrofixation was determined upon. An area of peritoneum the size of a thumbnail was removed from the anterior wall of the uterus one and one-half centimetres below the fundus, and the womb was stitched to the abdominal wall four centimetres above the symphysis by means of three silkworm-gut sutures. A Tait perineorrhaphy completed the operation. This was in April, 1895. In August the patient became pregnant, and was delivered of twins in April, 1896.

Grape-Sugar in the Urine and Amnionic Fluid. (*Centralblatt für Gynäkologie*, 1896, No. 25.) By Emil Rossa, M.D.

The patient was a rachitic primipara in the seventh month. Her urine was normal in amount, but showed a percentage of 0.46 of grape-sugar. When abortion was induced, three litres of amnionic fluid were obtained

containing 0.345 per cent. of grape-sugar. The first day after delivery the percentage of sugar in the urine was 0.38, the second day 0.92, and then gradually fell until the sixth day, when it disappeared entirely. The specific gravity was never higher than 1022, and averaged 1017.6 for the six days that sugar was present.

The urine obtained from the infant by catheterization contained no sugar.

OPHTHALMOLOGY.

IN CHARGE OF CHARLES A. OLIVER, A.M., M.D.,

Philadelphia, Pennsylvania,

AND

EDMUND LANDOLT, M.D.,

Paris, France.

Extraction of a Metallic Foreign Body from the Posterior Segment of the Eye by the Aid of an Electro-Magnet. Extraction des corps étrangers métalliques du segment postérieur de l'œil à l'aide de l'électro-aimant. (*Annales d'Oculistique*, Mars, 1896.) Rohmer has had the good fortune of extracting a piece of steel which measured one by two millimetres in size and weighed one milligramme from the vitreous humor by means of the electro-magnet of Chardin. The body was secured with the loss of but a few drops of vitreous after the third trial through a three-to four-millimetre incision made through the sclerotic,—at seven millimetres distance from the limbus cornea, between the insertions of the inferior and internal recti muscles.

The wound healed without any inflammatory reaction. Nearly a year later vision was normal and the eye remained perfectly quiet.

The Treatment of Subconjunctival Ecchymoses by Eserine. Le traitement par l'esérine des ecchymoses sous-conjunctivales. (*Annales d'Oculistique*, Mai, 1896.) In a brief though valuable communication, Hubert Burnham, of Toronto, Canada, draws attention to his success in the use of eserine in the treatment of subconjunctival hemorrhage of recurrent type. He has found that the drug is of value in producing rapid absorption of the effused blood, and that it seems to prevent recurrence of extravasation.

The Röntgen Ray in Ocular Surgery. Les rayons Röntgen en chirurgie oculaire. (*Archives d'Ophtalmologie*, Février, 1896.)

As the result of a series of experiments, Van Duyse, of Gand, has been able to obtain a radiograph of a leaden grain that he introduced into the posterior chamber of a rabbit's eye. The organ was made to protrude, and the plate was placed beneath it, the rays being allowed to pass from above.

He is of opinion that the method might be made of use in determining the presence of foreign objects in the anterior portion of the human eye, especially if an artificial exophthalmus can be produced by subconjunctival injections of normal salt solutions beneath the capsule of Tenon, the rays being allowed to pass nasally from the tube placed at the temporal side of the organ.

Upon the Employment of Dry Dressings and Powders in the Treatment of Affections of the Eye. Sur l'emploi des pansements secs et des topiques pulverulents secs dans le traitement des affections oculaires. (*Annales d'Oculistique*, Mars, 1896.)

In the treatment of eczematous and impetiginous inflammation of the lids, conjunctivitis especially of the phlyctenular type, keratitis even in the infectious varieties, Rogman, of Gand, has had most successful results with the tribasic sulpho-salicylate of bismuth,—so-called thioform. He has found it of great value in lessening conjunctival irritation and secretion from the improper wearing of artificial eyes.

FORENSIC MEDICINE.

IN CHARGE OF LORENZO D. BULETTE,
Of the Philadelphia Bar.

A CASE OF MALPRACTICE IN DIAGNOSTICATING OVARIAN TUMOR.

THE character of examination which may expose a physician to the liabilities for malpractice in diagnosing ovarian tumor was recently shown by the evidence in the trial of an action¹ for damages brought by one C., the husband of the patient, against Doctor B., the attending physician, and Doctor A., a specialist, who was the consulting physician, for negligence in making an examination of his wife, as a result of which the cause of her affliction was diagnosticated to be ovarian tumor, whereas the operation which was performed in consequence of such mistaken diagnosis disclosed the growth to be a fibroid tumor of the uterus. A verdict was rendered for both defendants, in accordance with the peremptory instruction of the trial court, and judgment was entered thereon; but the Supreme Court reversed this judgment as to Doctor A., the specialist, and directed judgment to be entered against him, while it affirmed the judgment in favor of Doctor B., the attending physician.

¹ Cheswold vs. Blank, 66 N. W. R. 819 (1896).

The mistake of the defendants in diagnosticating the cause of Mrs. C.'s affliction to be an ovarian tumor when the operation showed it to be a fibroid tumor of the uterus was clearly established. And the evidence bearing directly upon this subject was given by Doctor T., who, by invitation of the defendants, witnessed the operation, and who testified, in substance, that no tumor was removed from the person of the patient; also, by Mrs. B., proprietress of the hospital in the city of X., to which Mrs. C. had been taken for the purpose of the operation, who testified to a conversation with Doctor A. shortly thereafter, in which the latter remarked that the only tumors discovered during the operation were immovable fibroid tumors of the uterus, and in which conversation he requested the witness to make no statement concerning the subject to Mrs. C.'s friends. It was shown that Doctor B. made a superficial examination when first consulted upon the subject, which satisfied him respecting the cause of the illness from which Mrs. C. was suffering, and that the only other examination was made by Doctor A. in the presence of his co-defendant, the day preceding the operation. As to what transpired at the time last mentioned, the plaintiff testified: "Doctor A. made the examination. He first placed the patient in his chair, and exposed the abdomen, and with his hands pressed in every way, pushing and working the abdomen in every possible way. Then he took one hand, and tapped, and then the other; then one side, and then the other; and then from below. That is all the external examination he made. Then, after that, he inserted his finger in the vagina, and seemed to be feeling of the uterus. . . . I think the first remark was made by Doctor A. to Doctor B. He said, 'Doctor, it is just as you said.' My wife next asked the question, 'What is it?' He said, 'It is an ovarian tumor; no doubt about it.'" The time consumed in the examination, as here referred to by this witness, did not exceed ten minutes, and was made without the assistance of instruments of any kind.

The plaintiff called as witnesses several physicians and surgeons, who concur in the opinion that an operation should not be attempted for a suspected uterine or ovarian tumor without a most thorough examination of the person of the patient; and they agree that in all cases of doubt, where the theory of pregnancy is excluded, the uterus should be explored by means of a sound, in order to ascertain the depth of that organ. One witness, Doctor D., testified as follows:

"Q. Is there any case, except in which the tumor has attained such a size where the life of the patient demands its immediate removal, in which it can be said that the sounding of the uterus might be omitted from the diagnosis of the case, and still an attempt be made to perform an operation?

"A. No; I think there would be nothing to justify an operation in the case except something that would threaten the life of the patient. A complete and thorough examination of the case where an abdominal tumor is suspected would be by several methods: first, by palpation, which simply means the use of the hands over the abdomen; a feeling of the parts by

careful manipulation of the hands over the abdomen, and percussion or tapping of the parts with the fingers externally, or with some instrument, to get the sounds elicited by percussion ; an examination of the parts that can be reached through the vagina ; by measurement of the abdomen as to the breadth and height of the mass ; an examination with the vaginal speculum ; and in many other cases, and in all cases of doubt, where pregnancy is absent, the use of the uterine sound.

"Q. Are the methods of examination you have suggested necessary and indispensable to a careful and proper examination of the patient, where pregnancy does not exist and the presence of a tumor is suspected ?

"A. Yes, sir ; of course, where there is a prospect of an operation, it always demands a more careful examination, if possible, than a man would make simply for the purpose of trying to tell the patient in a general way what the matter is. The very fact that a man is going to make an operation increases his responsibility in diagnosing the case, and he had better make a mistake where he is not going to operate than where he is."

Doctor R., another witness, testified that the surgeon should be able, by means of conjoined manipulation, to determine, "to a tolerable certainty," the size and location of the tumor, and whether it is liquid or solid ; that, if connected with the uterus, it is pretty certain to be solid, and, if connected with the ovaries, it is pretty certain to be a cyst.

Mr. Chief-Justice Post, in delivering the opinion of the Supreme Court, said, "It is not pretended that there was in this instance any suspicion of pregnancy, and no objection existed on that ground to the exploration of the uterus in determining the location and character of the tumorous growth. Nor can it, on the record before us, be contended that this case is within the other exception mentioned by Doctor D.,—namely, where the condition of the patient is so critical as to require heroic treatment, and where an operation is justifiable as a last resort, without the precautionary sounding of the uterus. The testimony of the medical witnesses tends, therefore, directly to prove the wrong alleged,—namely, negligence in the examination of the plaintiff's wife, and the consequent unfortunate result thereof.

"We agree with counsel for the defendants that physicians and surgeons are not required to exercise the utmost degree of care or to possess the highest attainable skill in their profession. They do, however, by virtue of the relation assumed by them towards patients, impliedly engage that they possess ordinary skill, and that they will, in the course of their employment, exercise such necessary and proper care and attention as may reasonably be expected from members of their profession under like circumstances.

"There being competent proof upon the vital issue of the case, and tending to sustain the cause of action charged against one of the defendants, a question was presented for submission to the jury, and the direction in favor of both defendants at the conclusion of the plaintiff's evidence

was error, calling for a reversal of the judgment, so far, at least, as it applies to Doctor A. It remains to be determined whether the court erred in directing a verdict in favor of Doctor B. Upon that question the conclusion reached from an examination of the record is that the engagement and responsibility of the last-named defendant terminated with the employment of Doctor A. When first consulted upon the subject, he advised the plaintiff to consult some physician who was a specialist in that line, saying that he did not consider himself qualified to perform the required operation. To the question, 'Did Doctor B. say who you had better go to?' the plaintiff answered, 'I don't think he advised any one very strong. The idea was to get the best doctor.' His attitude towards the case after surrendering the patient to the care and treatment of Doctor A. was that of friend and counsellor only, and in no sense that of a physician or surgeon. The direction in his favor was accordingly right, and the judgment as to him will be affirmed; but the judgment for the other defendant, Doctor A., is reversed."

BOOK REVIEWS.

DISEASES OF THE EYE. *A Hand-Book of Ophthalmic Practice.* By G. E. de Schweinitz, M.D., Professor of Ophthalmology in the Jefferson Medical College, Philadelphia, etc. A handsome royal octavo volume of 679 pages, with 256 fine illustrations, many of which are original, and 2 chromo-lithographic plates. Prices: Cloth, \$4.00 net; sheep or half-morocco, \$5.00 net.

The second edition of this work contains a great deal of new matter, and instead of the bibliography of the first edition the author has added an appendix. In the latter we find a full description of the method of determining the corneal astigmatism with the ophthalmometer of Javal and Schiötz, and the rotations of the eyes with the tropometer of Stevens. The chapter on operations consists of eighty pages clearly illustrated; the descriptions of various steps employed are so plain and direct that the book has become a most valuable guide to students and practitioners. New paragraphs are introduced on the subjects of filamentous keratitis; blood-staining of the cornea; essential phthisis bulbi; foreign bodies in the lens; circinate retinitis; symmetrical changes in the macula lutea in infancy; hyaline bodies in the papilla; monocular diplopia; germicides; the use of Schleich's infiltration anaesthesia; and the sterilization of collyria. The chapters on general optical principles and on normal and abnormal refraction, originally written by Dr. James Wallace, have been revised by Dr. Edward Jackson, and thus made doubly valuable.

The descriptions of the tests for astigmatism are clear and the illustrations for the use of the Maddox rod and the diagram explaining the method of focussing the vessels by the meridians of an astigmatic eye are good examples of the way in which the illustrations teach. There is a little carelessness on page 117 where a note seems to have been omitted, and also on page 609 where the references are defective.

The publisher requests us to state that the following errors, which occurred in

the first few copies of the work, have been corrected. On pages 518-520, Fig. 163 should be where Fig. 166 now is; Fig. 166 should be where Fig. 165 now is; Fig. 165 should be where Fig. 163 now is. G. H.

FUNCTIONAL DISORDERS OF THE NERVOUS SYSTEM IN WOMEN. By T. J. McGillicuddy, A.M., M.D. New York: William Wood & Co. 8vo, 367 pp.

The author states that he writes from the stand-point of the general practitioner; one-fourth of the book is therefore given up to therapeutics, and this is really the valuable part of the publication. The full directions as to the use of food and stimulants will be read with profit and will be found to rest on a sound basis. Examples are given of reflex neuroses from every conceivable source, particular attention being paid to hysteria and hystero-epilepsy. The author would give his hearers a false sense of security when he says, "Another mistake which is often made is to call tubercle bacilli the sole cause of tuberculous infection, since tuberculosis will never affect people with good constitutions, but only those with poor, broken-down constitutions. People with good constitutions may continually inhale the bacilli without any bad effects whatever." It would hardly seem necessary to adduce evidence to prove that even the most robust man, the most finished athlete, is liable to become infected with tuberculosis in its most rapidly progressing type. Indeed, this is a common cause of death in prize-fighters in spite of their remarkable physique. The large number of clinical histories which are recorded in this volume afford much interesting reading. G. H.

MANUAL OF MIDWIFERY, for the Use of Students and Practitioners. By W. E. Fothergill, M.A., B.Sc., M.B., C.M. New York: The Macmillan Company. Price, \$2.25.

Embodying as it does the teachings of the Edinburgh School of Obstetrics, this excellent little book should certainly recommend itself to both students and practitioners. Its four hundred and seventy-five pages make its size convenient, its style is excellent, its arrangement is systematic and comprehensive, and its seventy illustrations have been carefully selected, many of them being from original drawings and photographs.

In Chapter II., under the Functions of the Female Reproductive Organs, the most recent and most generally accepted theories of menstruation, ovulation, and conception are discussed. Chapters III., IV., and V. present an excellent description of the formation and fate of the decidua, and the growth of the early ovum with its membranes and placenta. The author has succeeded in giving a very clear and at the same time a condensed account of these complicated embryological processes. In the chapter on ectopic gestation the latest views of Webster, Sutton, Tait, Hart, and Martin are discussed, and these abnormal pregnancies are classified according to their views.

The mechanism of labor is simplified by division into four movements of the head instead of the more complicated theoretical German classification. The description of the movements is clear and concise; they are (1) flexion, (2) internal rotation, (3) extension, and (4) external rotation. The author holds that the child's head is bent upon the chest from the first so that the term flexion has nothing to do with the position of the head relative to the body of the child but to the pelvis of the mother, and that the word is therefore misleading. Flexion is due to the less resistance presented to the descending part by the short anterior wall of the pelvis; it results from the more rapid descent of the anterior part. Internal rotation, "the movement of the leading part from the side of the pelvis to the front," is accounted for by Hart's theory that "whatever part of the fetal head or trunk first strikes a lateral part of the sacral segment is rotated internally to the front. . . . The direc-

tion of rotation may be predicted in any case by noting what part first strikes persistently a lateral half of the sacral segment."

Extension is not a movement in which the chin leaves the sternum; the head continues to advance until the occiput passes under the pubic arch and the sinciput passes over the distended perineum, and no part of the head is arrested during the whole process.

Following the Mechanism of Labor is a chapter on the Sectional Anatomy of Labor, with a discussion of the third stage, based on five frozen sections of which excellent full-page cuts are given. The author rejects the theory of placental separation by blood extravasation, and inclines to a combination of the theories of detrusion and disproportion between the placental area and the placental site.

The chapter on the management of normal labor contains many useful hints in regard to instruments, examinations, preliminaries, and the management of the labor itself.

Placenta prævia, accidental hemorrhage, retained and adherent placenta, and postpartum hemorrhage receive careful attention, especial emphasis being given to the use of hot water in the last condition.

The evolution of the forceps, their action, the indications for their use, and the method of their application are treated quite fully and illustrated by a number of excellent cuts. In the opinion of the author the axis-traction forceps, of which the Simpson-Tarnier and the R. Milne Murray are the best, should supersede all others, as with them traction must always be made parallel to the axis of the parturient canal, no matter what the position of the head.

In the discussion of version *versus* forceps the advice is given that podalic version should not be used in cases of difficulty when the head presents, and that where possible cephalic version should always be attempted.

L. S. S.

ITEMS OF INTEREST.

IN Great Britain the Society of Medical Phonographers has been founded to promote the use of phonetic short-hand in medical work. This society has made steady progress, and it now numbers two hundred and fifty names on its membership roll. This society issues the *Record*, a monthly medical periodical in lithographed short-hand, and has recently published two small pamphlets dealing with the use of short-hand by the student and by the practitioner respectively. More recently a list of twenty-five hundred phonographic outlines of medical terms has been issued. The value of short-hand as a means of securing not only adequate records of facts, but of intercommunication, has led to the establishment of various circulating manuscript magazines, each of which presents the advantages of a small medical society even to those who are in remote parts of the kingdom, while at the same time affording practice in reading. The annual subscrip-

The Society of
Medical Pho-
nographers.¹

¹ British Medical Journal, September 12, 1896.

tion to the society, which is five shillings, or in the case of students before qualification three shillings, entitles the subscriber to receive post-free all the phonographic literature issued by the society for the year. The society has petitioned the general medical council to make short-hand an optional mark-bearing subject at the preliminary examination. The educational committee of the council has had this petition under consideration and will report on it at the next meeting. Dr. Gowers has been chiefly instrumental in securing the organization of the society.

The sixth annual meeting of the American Electro-Therapeutic Association was held in Allston Hall, Boston, Massachusetts, September 29 and 30 and October 1, 1896. There was a good attendance and many papers of scientific interest and therapeutic value were read. An exhibition of modern electrical apparatus, such as batteries, static machines, meters, current controllers, electrodes, etc., as well as other instruments, was held in connection with the meetings.

Consular Agent Landgraf, at Bloemfontein, says that no country on earth can rank with the Orange Free State as a health-resort. That so few people go there is due to the fact that the country is so little known. In the majority of countries it is believed to be a desert, inhabited by brutal natives and wild beasts. The country, in fact, is pretty well populated and cultivated. Living is rather expensive, and persons intending to go there to reside should command from fifty to sixty dollars per month. A family of four persons can live decently on fifteen hundred dollars a year. Persons in advanced stages of tuberculosis of the lungs should travel by stages from the sea to Orange Free State. Such patients should stay a month at Ceres, and then for a time at Beaufort West, until they are prepared to stand the dry climate. A direct journey to Bloemfontein would mean death to such persons. Capetown is the landing place.

Climate of the
Orange Free
State.¹

¹ Sanatorium, September, 1896.